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THE PRACTICE OF PHARMACY

A TREATISE

ON THE MODES OF MAKING AND DISPENSING OFFICIAL, UNOFFICIAL, AND EXTEMPORANEOUS PREPARATIONS, WITH DESCRIPTIONS OF MEDICINAL SUBSTANCES, THEIR PROPERTIES, USES, AND DOSES

INTENDED AS

A HAND-BOOK FOR PHARMACISTS AND PHYSICIANS

AND

A TEXT-BOOK FOR STUDENTS

SIXTH EDITION

VOL. I

BY

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WITH OVER EIGHT HUNDRED ILLUSTRATIONS

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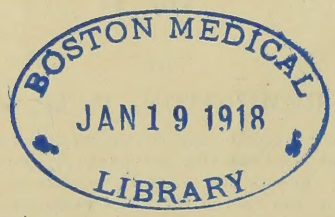

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PREFACE TO THE SIXTH EDITION

THE publication of the Ninth Decennial Revision of the United States Pharmacopœia and the Fourth Edition of the National Formulary, together with the introduction of many new remedies and processes, and the continued advance in pharmaceutical knowledge in recent years have rendered necessary a new edition of the Practice of Pharmacy.

Notwithstanding the efforts of the author to limit the number of pages by eliminating undesirable subjects, the pressing need of a comprehensive handbook which would serve as a daily companion for the busy pharmacist has necessitated an increase in the size of the book. As it is also a text-book, it is of paramount importance to present the subjects in proper sequence and introduce syllabi and tables which will enable the student to grasp quickly the outlines of the general subjects. The first edition of this work was published in October, 1885, and thus thirty-two years have elapsed between the first and last editions. This period has been one of ceaseless activity in the pharmaceutical world, and the effort has been made by the author to keep pace with progressive pharmacy in at least a creditable measure.

This revision is marked by many changes and additions and the illustrations have been revised by the author's son, J. Percy Remington, B.S., P.D., most of the outline drawings having been made by him, and new cuts reproduced from these.

Since the advent of the first edition of the Practice of Pharmacy the book has had an ever-widening field, and, since the National Formulary has been recognized as one of the standards under the National Food and Drugs Act and in the laws of many states, it has been deemed desirable to introduce its formulas into this Edition, immediately following the U. S. P. preparations. The preparations of the British Pharmacopœia, when dissimilar from those official in the United States Pharmacopœia, are also included, but in tabular form. Dismissed preparations of the previous Pharmacopœia, which still have considerable vogue, have also found a place.

The metric system of weights and measures has been given the preference in the working formulas, not only for the reason that it is the official method of indicating quantities, but because it is the simplest and best system in use. Unfortunately, the old-form quantities con-

tinue to be most largely employed in buying and selling drugs and in prescription work; hence, alternative formulas are appended to official preparations, as in previous revisions.

The old-form quantities are not intended to be the equivalents of the metric quantities, and the two systems are not interchangeable; either "metric" or "old form" may be used, but in no case part of one and part of the other; different type distinguishes one from the other.

Part V, which is devoted to magistral or extemporaneous pharmacy, has been extensively enlarged by the addition of new articles on sterilization, ampul filling, tablet making, etc., with numerous new cuts of apparatus with descriptions. The condensed charts of inorganic chemical substances, vegetable official drugs, and animal substances have been thoroughly revised; these will be found very useful for students in preparing for examination, by enabling them to review the whole subject.

Part VI presents an alphabetical arrangement of many unofficial but largely used preparations and special formulas. These can now be quickly found by the busy pharmacist, black-letter titles being used.

The Sixth Edition will be published as heretofore in one volume, but for the convenience of students this Edition has also been issued in two volumes, the second volume beginning with inorganic chemicals.

Acknowledgments are tendered to E. Fullerton Cook, P.D., and B. A. Heims, who have given valued assistance in every part of the revision. These services are hereby gratefully recognized, particularly as they were rendered immediately after the arduous labors upon the revision of the United States Pharmacopœia had been completed.

In closing, the author desires to express his great appreciation of the reception of this work by his friends in many countries, and to venture the hope that the present edition adequately reflects the progress made in pharmaceutical practice since the last revision.

J. P. R.

PHILADELPHIA, May, 1917.

PREFACE TO THE FIRST EDITION

THE rapid and substantial progress made in Pharmacy within the last decade has created a necessity for a work treating of the improved apparatus, the revised processes, and the recently introduced preparations of the age.

The vast advances made in theoretical and applied chemistry and physics have had much to do with the development of pharmaceutical science, and these have been reflected in all the revised editions of the Pharmacopœias which have been recently published. When the author was elected in 1874 to the chair of Theory and Practice of Pharmacy in the Philadelphia College of Pharmacy, the outlines of study which had been so carefully prepared for the classes by his eminent predecessors, Professor William Procter, Jr., and Professor Edward Parrish, were found to be not strictly in accord, either in their arrangement of the subjects or in their method of treatment. Desiring to preserve the distinctive characteristics of each, an effort was at once made to frame a system which should embody their valuable features, embrace new subjects, and still retain that harmony of plan and proper sequence which are absolutely essential to the success of any system.

The strictly alphabetical classification of subjects which is now universally adopted by pharmacopœias and dispensatories, although admirable in works of reference, presents an effectual stumbling-block to the acquisition of pharmaceutical knowledge through systematic study; the vast accumulation of facts collected under each head being arranged lexically, they necessarily have no connection with one another, and thus the saving of labor effected by considering similar groups together, and the value of the association of kindred subjects, are lost to the student. In the method of grouping the subjects which is herein adopted, the constant aim has been to arrange the latter in such a manner that the reader shall be gradually led from the consideration of elementary subjects to those which involve more advanced knowledge, whilst the groups themselves are so placed as to follow one another in a natural sequence.

The work is divided into six parts. Part I. is devoted to detailed descriptions of apparatus and definitions and comments on general pharmaceutical processes.

The Officinal Preparations alone are considered in Part II. Due weight and prominence are thus given to the Pharmacopœia, the National authority, which is now so thoroughly recognized.

In order to suit the convenience of pharmacists who prefer to *weigh*

solids and *measure liquids*, the officinal formulas are expressed, in addition to parts by weight, in *avoirdupois weight* and *apothecaries' measure*. These equivalents are printed in *bold type*, near the margin, and arranged so as to fit them for quick and accurate reference.

Part III treats of Inorganic Chemical Substances. Precedence is of course given to officinal preparations in these. The descriptions, solubilities, and tests for identity and impurities of each substance are systematically tabulated under its proper title. It is confidently believed that by this method of arrangement the valuable descriptive features of the Pharmacopœia will be more prominently developed, ready reference facilitated, and close study of the details rendered easy. Each chemical operation is accompanied by equations, whilst the reaction is, in addition, explained in words.

The Carbon Compounds, or Organic Chemical Substances, are considered in Part IV. These are naturally grouped according to the physical and medical properties of their principal constituents, beginning with simple bodies like cellulin, gum, etc., and progressing to the most highly organized alkaloids, etc.

Part V is devoted to Extemporaneous Pharmacy. Care has been taken to treat of the practice which would be best adapted for the needs of the many pharmacists who conduct operations upon a moderate scale, rather than for those of the few who manage very large establishments. In this, as well as in other parts of the work, operations are illustrated which are conducted by manufacturing pharmacists.

Part VI contains a formulary of Pharmaceutical Preparations which have not been recognized by the Pharmacopœia. The recipes selected are chiefly those which have been heretofore rather difficult of access to most pharmacists, yet such as are likely to be in request. Many private formulas are embraced in the collection; and such of the preparations of the old Pharmacopœias as have not been included in the new edition, but are still in use, have been inserted.

In conclusion, the author ventures to express the hope that the work will prove an efficient help to the pharmaceutical student as well as to the pharmacist and the physician. Although the labor has been mainly performed amidst the harassing cares of active professional duties, and perfection is known to be unattainable, no pains has been spared to discover and correct errors and omissions in the text. The author's warmest acknowledgments are tendered to Mr. A. B. Taylor, Mr. Joseph McCreery, and Mr. George M. Smith for their valuable assistance in revising the proof-sheets, and to the latter especially for his work on the index. The outline illustrations, by Mr. John Collins, were drawn either from the actual objects or from photographs taken by the author.

J. P. R.

PHILADELPHIA, October, 1885.

CONTENTS

INTRODUCTORY

PAGE

Theoretical and Practical Pharmacy 25
Pharmacopœias and Dispensatories 26
NOMENCLATURE 29
NATIONAL FORMULARY 37
DISPENSATORIES 38
QUESTIONS ON INTRODUCTORY CHAPTER 39

PART I

CHAPTER I

METROLOGY

Weights, Measures, and Specific Gravity 41
Weight 41
Measures 44
Metric System 45
Table of Metric and Old Form Equivalent Weights and Measures 50
Orthography, Pronunciation, and Reading 59
Weighing and Measuring 60
Metallic Weights used in Pharmacy 70
Measuring Liquids 73
Table exhibiting the Number of Drops in a Fluidrachm of Different Liquids . 77
Specific Gravity 78
Specific Gravity of Liquids 81
Hydrometers 83
Methods of taking the Specific Gravity of Small Quantities of Liquids . . . 88
Table giving the Specific Gravities of Pharmacopœial Substances, arranged in the Order of their Densities 90
Specific Volume 92
Table of Weight and Volume Relations 94
Practical Problems and Exercises illustrating the Uses of Weights, Measures, Specific Gravity, and Specific Volume 95
Alligation Applied to Pharmacy 101
Answers to Practical Problems and Exercises 108
Questions on Metrology 112

CHAPTER II

Operations requiring the Use of Heat 116
Generation of Heat 116
Operations and Forms of Apparatus in which Solids are used in developing Heat 116
Operations and Forms of Apparatus in which Liquids are used in developing Heat 119
Operations and Forms of Apparatus in which Gases are used in developing Heat 122
Operations and Forms of Apparatus in which Electricity is used in developing Heat 125
Methods of measuring Heat 126
Table of Melting Points of Official Substances 132

CHAPTER III

Uses of Heat 136
Operations in which comparatively High Temperatures are required 136
Operations requiring Heat in which Lower Temperatures are used 139
Table of Boiling Points of Saturated Solutions of Various Salts. 140
The Use of Steam in Pharmaceutical Operations 141
Table of the Temperatures of Superheated Steam 142

CHAPTER IV

PAGE
Vaporization 147
Evaporation 147
Table of Boiling or Distilling Points of Official Substances 149

CHAPTER V

Distillation 160
Condensation 160
Liebig Condenser 169
Pharmaceutical Stills 171

CHAPTER VI

Sublimation 181
Cake Sublimates 181
Powder Sublimates 182

CHAPTER VII

Desiccation 184
Table showing Loss in Powdering Medicinal Substances 188

CHAPTER VIII

Comminution 189
Drug Mills 193
Trituration 202
Spatulas 204
Sifting 205
Fineness of Powder 206
Levigation 207
Elutriation 208
Trochiscation 208
Pulverization by Intervention 209

CHAPTER IX

Solution 211
Solution of Solids 211
Simple Solution 211
Chemical Solution 211
Modes of effecting Solutions of Solids 212
Solvents used in Pharmacy 213
Solubility as a Test 214
Table of the Solubility of Official Substances in Water and in Alcohol 215
Solution of Gases in Liquids 220
Colloidal Solutions 220

CHAPTER X

Separation of Fluids from Solids 222
Lotion, or Displacement Washing 222
Continuous Washing 222
Decantation 223
The Syphon 224
Colation, or Straining 226

CHAPTER XI

Filtration 229
Paper Filters 229
Methods of folding Filtering Paper 230
Funnels 233
Filters for Special Purposes 235
Continuous Filtration 237

PAGE
Filtration of Volatile Liquids 237
Hot Filtration 238
Rapid Filtering Apparatus. 239
Water Pumps acting by a Fall of Water. 239
Water Pumps acting by Pressure 241

CHAPTER XII

Clarification and Decoloration 245
Clarification 245
Decoloration 247

CHAPTER XIII

Separation of Immiscible Liquids. 249
Use of the Pipette 249
Use of the Glass Syringe 249
Use of the Separating Funnel 250
Mitchell's Separator 250
Florentine Receiver. 250

CHAPTER XIV

Precipitation 252
The Objects of Precipitation. 252
Methods of effecting Precipitation 252
Vessels used in Precipitation. 253
Manner of conducting the Process 253
The Production of Heavy and Light Precipitates. 253
Collecting and washing Precipitates 254

CHAPTER XV

Crystallization 255
Systems in Crystallography 256
Determination of Crystalline Form 257
Cleavage 257
Methods of obtaining Crystals 258
Water of Crystallization 260
Mother Liquor. 261
Crystallizing Vessels 261
Collection, Draining, Washing, and Drying of Crystals 261
Intermediate Crystallization. 262

CHAPTER XVI

Granulation and Exsiccation. 264
Granulated Effervescent Salts 264

CHAPTER XVII

Dialysis 266

CHAPTER XVIII

Extraction 269
Maceration 269

CHAPTER XIX

Expression 271
Spiral Twist Press 271
Screw Press 271

PAGE
Roller Press . . . 275
Wedge Press . . . 275
Lever Press . . . 275
Hydrostatic or Hydraulic Press . . . 276
Centrifugal Machines or Centrifuges . . . 278

CHAPTER XX

Percolation . . . 280
History . . . 280
Principle of Action . . . 280
Shape of the Percolator . . . 284
Comminution . . . 285
Moistening of the Powder . . . 285
Packing the Powder . . . 286
Adding the Menstruum . . . 287
Previous Maceration . . . 287
Finishing the Process . . . 288
Choice of Menstrua . . . 288
Absorbed Menstruum . . . 289
Controlling the Flow of the Percolate . . . 289
Special Percolators . . . 290
Methods of Supporting Percolators . . . 296
Percolation Closet . . . 297
Receiving Bottles . . . 297
Repercolation . . . 298
Fractional Percolation . . . 298

PART II

Official Pharmacy . . . 301
Introductory . . . 301
Classification of Official Preparations . . . 301

CHAPTER XXI

Aqueous Solutions . . . 302
Aquæ. Waters . . . 302
Simple Solution in Cold Water . . . 302
Solution in Hot Water . . . 303
Filtration through an Absorbent Powder . . . 303
Filtration through Pulped or Shredded Filter Paper . . . 303
Percolation through Cotton impregnated with the Substance . . . 303
Distillation . . . 304
Official Waters . . . 305
Liquores. Solutions . . . 311
Simple Solutions (Aqueous) . . . 312
Chemical Solutions (Aqueous) . . . 312
Table of Unofficial Solutions . . . 315

CHAPTER XXII

Aqueous Solutions containing Sweet or Viscid Substances . . . 317
Syrupi. Syrups . . . 317
Official Syrups . . . 320
Classification of Unofficial Syrups . . . 325
Mellita. Honeys . . . 350
Classification of Official Honeys . . . 350
Mucilagines. Mucilages . . . 352
Classification of Official Mucilages . . . 352
Emulsa. Emulsions . . . 354
Classification of Official Emulsions . . . 354
Misturæ. Mixtures . . . 360
Table of Official Mixtures . . . 360
Unofficial Mixtures . . . 362
Magmæ. Magmas . . . 370

PAGE
Table of Official Magmas 370
Lotiones. Lotions 371
Table of Official Lotions 371
Glycerita. Glycerites 373
Table of Official Glycerites 373
Unofficial Glycerites 374

CHAPTER XXIII

Alcoholic Solutions 382
Spiritus. Spirits 382
Spirits made by Simple Solution 382
Spirits made by Solution with Maceration 383
Spirits made by Gaseous Solution 384
Spirits made by Chemical Reaction 384
Spirits made by Distillation 384
Unofficial Spirits 385
Official Spirits 385
Elixiria. Elixirs 393
Official Elixirs 393
Unofficial Elixir 400
Cordialia. Cordials 424
Official Cordial 425

CHAPTER XXIV

Ethereal Solutions 427
Collodia. Collodions 427
Table of Official Collodins 427
Official Collodins 427

CHAPTER XXV

Oleaginous Solutions or External Applications 430
Linimenta. Liniments 430
Table of Official Liniments 430
Table of Unofficial Liniments 431
Official Liniments 432
Oleata. Oleates 436
Table of Official Oleates 437
Table of Unofficial Oleates 437
Official Oleates 437
Petroxolina. Petroxolins 439
Table of Official Petroxolins 440
Official Petroxolins 441
Nebulæ. Sprays 445
Table of Official Sprays 445
Official Sprays 446

CHAPTER XXVI

Aqueous Liquids made by Percolation or Maceration 449
Infusa. Infusions 449
Table of Official Infusions made by Maceration 451
Table of Official Infusions made by Percolation 452
Official Infusions 453
Table of Unofficial Infusions 456
Decocta. Decoctions 456
Official Decoctions 457
Table of Unofficial Decoctions 458
Species 458
Official Species 459

CHAPTER XXVII

Alcoholic Liquids made by Percolation or Maceration 461
Tincturæ. Tinctures 461
Table of Official Tinctures 464

PAGE
Table of Unofficial Tinctures 468
Official Tinctures 469
Vina Medicata. Medicated Wines 512
Table of Official Wines 513
Official Wines 514
Table of Unofficial Wines 519
Fluidextracta. Fluidextracts 519
Table of Official Fluidextracts 529
Table of Unofficial Fluidextracts 534
Official Fluidextracts 535

CHAPTER XXVIII

Oleoresinous Liquids made by Percolation, Etc. 598
Oleoresinæ. Oleoresins 598
Table of Official Oleoresins 599
Official Oleoresins 599

CHAPTER XXIX

Acetous Liquids made by Percolation 603
Aceta. Vinegars 603
Table of Official Vinegars 603
Table of Unofficial Vinegars 603
Official Vinegars 604

CHAPTER XXX

Solid Preparations made by Percolation 606
Extracta. Extracts 606
Table of Official Extracts 612
Table of Unofficial Extracts 618
Official Extracts 618
Resinæ. U. S. Resins 642
Table of Official Resins 642
Official Resins 642

CHAPTER XXXI

Solid Official Preparations made without Percolation 647

LIST OF ILLUSTRATIONS

FIG.		PAGE
1.	Graduated medicine glass	45
2.	Metric diagram	46
3.	Illustration of equilibrium	61
4.	Position of knife edges	61
5.	Manner of holding scales	62
6.	Hand scale with sliding weight	62
7.	"Stansico" dissectible balance	63
7*a*.	"Stansico" balance dissected	63
8.	Fine prescription balance	64
9.	Analytical balance	64
10.	Enlarged view of the end of beam of analytical balance	65
11.	Old-style counter scales	65
12.	Scale with graduated parallel beam and sliding weight	65
13.	Fairbank's druggists' scale	66
14.	Ball scale	66
15.	Vest pocket prescription scale	66
16.	Troemner's scale for weighing liquids	67
17.	Counter scales in "glass box"	67
18.	Box prescription scales	68
19.	Ritchie torsion balance	68
20.	Frame	69
21.	Frame with wire	69
22.	Torsion prescription balance	69
23.	Part of the rider beam	69
24.	Torsion counter scale	70
25.	Common avoirdupois weights	71
26.	Avoirdupois weights in metal frame	71
27.	Cup troy weights	71
28.	Metric weights (iron)	72
29.	Metric weights (block)	72
30.	Metric weights (analytical)	72
31.	Prescription weights	72
32.	Aluminum wire weights	73
33.	Aluminum grain weights	73
34.	Tinned copper gallon measure	73
35.	Laboratory measure	73
36.	Tumbler-shaped graduate	74
37.	Metric graduate	74
38.	Cylindrical graduate	74
39.	Graduate hook	74
40.	Minim measure	75
41.	Minim pipette	75
42.	Minim pipette with bottle	76
43.	Taking the specific gravity of a solid	78
44.	1000 grain bottle	79
45.	Counterpoise	79
46.	Graduated specific gravity tube	79
47.	Specific gravity bottle	81
48.	Squibb's pycnometer with leaden collar	82
49.	Squibb's pycnometer with leaden collar	82
50.	Lovi's beads	82
51.	Baumé's hydrometer	83
52.	Scales of specific gravity hydrometer	84
53.	Scales of specific gravity hydrometer	84
54.	Hydrometer jar	85
55.	Urinometer and jar (Squibb)	85
56.	Alcoholmeter	86
57.	Nicholson's hydrometer	88
58.	Mohr's specific gravity apparatus	88
59.	Westphal specific gravity balance	89
60.	Rousseau's densimeter	90
61.	Specific volume bottle	93
63.	Pharmaceutical furnace (sectional view)	117
64.	Pharmaceutical range	118
65.	Pharmaceutical furnace	118
66.	Spirit lamp	119
67.	Alcohol stoves	119
68.	Alcohol stoves	119
69.	Russian blast lamp	120
70.	Gasoline stove	120
71.	Wickless blue flame coal oil stove	121
72.	Wickless blue flame coal oil stove	122
73.	Gas flame	122
74.	Bunsen burner (sectional view)	123
75.	Bunsen burner (Morton's)	123
76.	Short burner	123
77.	Short burner with support	123
78.	Fletcher's radial burner	124
79.	Horizontal Bunsen burner	124
80.	Springfield laboratory burner	124
81.	Economy gas stove	124
82.	Water heater	125
83.	Hot water heater	126
84.	Electric stoves	126
84*a*.	Electric stoves	126
85.	Centigrade thermometer	127
86.	Fahrenheit thermometer	127
87.	Paper scale thermometer	127
88.	Fahrenheit thermometer	127
89.	Centigrade thermometer	127
90.	Réaumur thermometer	127
91.	Clinical thermometer	128
92.	Taking the melting point	128

FIG. PAGE

93a. 93b. Bensemann's method of collecting fusible body 128
94. Apparatus for taking melting points 130
95. Plain blowpipe 136
96. Bulb blowpipe 136
97. Black's blowpipe 136
98. Berzelius's blowpipe 136
99. Plattner's blowpipe 136
100. Plattner's blowpipe (dissected) . 136
101. Gas blowpipe 137
102. Foot bellows 137
103. Hessian crucible. 137
104. Fletcher's gas crucible furnace . 137
105. Platinum crucible 138
106. Crucible tongs 138
107. Sand bath 139
108. Water bath 140
109. Water bath (porcelain dish) . . 140
110. Copper water bath 141
111. Open steam bath 141
112. Steam distributor 141
113. Use of steam under pressure . . 143
114. Steam boiler 143
115. Steam boiler (sectional view) . . 143
116. Steam kettle 143
117. Steam kettle (sectional view) . . 144
118. Steam kettle on trunnions . . . 144
119. Tilting steam kettle with stirrer. 144
120. Enamelled steam kettle 144
121. Kettle with steam coil 145
122. Upright steam coil. 145
123. Horizontal steam coil 145
124. Zigzag steam coil 145
125. Steam kettle for use over naked fire 145
126. Boiling point test 148
127. Evaporation by boiling. 151
128. 129. Evaporation below the boiling point 152
130. Porcelain evaporating dish . . . 152
131. Glass evaporating dish. 152
132. "Agate ware" evaporating dish. 152
133. Porcelain stirrer 153
134. Double stirrer. 153
135. Horn stirrer. 153
136. Wooden stirrer 153
137. Bent horn stirrer 153
138. Rotary stirrer. 153
139. Small vacuum apparatus 153
140. Vacuum apparatus 154
141. Vacuum apparatus (Stokes') . . 154
142. Evaporating chamber 155
143. Surface evaporation 156
144. Flask evaporation 156
145. Graduated evaporating dish . . 157

FIG. PAGE

146. Measuring evaporation. 157
147. Hood 157
148. Stove hood 158
149. Grommets 158
151. Alembic 160
152. Japanese lambik. 160
153. Plain retort. 161
154. Tabulated retort 161
155. Distilling flask 161
156. Tube properly bent 162
157. Tube unequally heated. 162
158. Tube hastily bent 162
159. Holding the tube 163
160. 161. 162. Tubes properly and improperly drawn. 163
163. Cork borers. 163
164. Cork borer (large size) 164
165. Rat tail file. 164
166. Rasp and file 164
167. 168. Bladder joints 164
169. Rubber joint 165
170. Tubulated receiver 165
171. Tubulated and quilled receiver . 165
172. Plain receiver. 165
173. Mode of using quilled receiver . 166
174. 175. 176. 177. 178. 179. Adapters 166
180. Use of adapter 166
181. Stoppered funnel tube 166
182. Funnel tube 166
183. Thistle top funnel tube. 166
184. Improvised funnel tube 167
185. Charging a plain retort. 167
186. Welter's safety tube 167
187. Retort stand 167
188. Retort ring clamp 167
189. Retort ring 167
190. Ring with split sections of rubber tubing. 167
191. Apparatus stand 168
192. Apparatus stand (horizontal) . . 168
193. Bunsen's clamp 168
194. Liebig condenser 169
195. Liebig condenser (all glass, rubber joints) 169
196. Liebig condenser in use 169
197. Squibb's pinchcock (open) . . . 170
198. Squibb's pinchcock (closed). . . 170
199. Spring pinchcock (Mohr's) . . . 170

FIG. PAGE

200. Screw pinchcock (Hoffman's) . . 170
201. Pinchcock (Remington's) 170
202. Tube condenser in use 170
203. Condensing worm 171
204. Wiegand's still 172
205. Curtman's still 172
206. 207. Pharmaceutical still. 173
208. Game's still. 173
209. Stevens's still. 173
210. Rice's still and condenser. . . . 175
211. Remington still 176
212. Remington still (sectional view). 178
213. Wire cage 178
214. Automatic water still (Stokes') . 179
215. Sublimation of benzoic acid. . . 181
216. Subliming apparatus (cake). . . 181
217. Subliming apparatus (powder) . 182
218. Desiccating frame and trays . . 185
219. Pharmaceutical drying closet . . 185
220. Drying closet (gas heat) 185
221. Drying oven 186
222. Desiccator 187
223. Tobacco cutter 189
224. Roller knife. 190
225. Rotary cutter 190
226. Mortar and pestle (on a mortar block) 191
227. Buhrstone mill 193
228. Buhrstone 193
229. Grooved rollers 194
230. Grooved rollers (cross section) . 194
231. Chasers 194
232. Chasers (curved grinding surface) 194
233. Single jar mill. 195
234. Double jar mill 195
235. Battery of pebble mills. 196
236. Mead's disintegrator 197
237. Revolving disk and screens . . . 197
238. Max mill 197
239. Enterprise drug mill 199
240. Drug mill (dispensing) 199
241. Quaker City F. No. 4 mill. . . 200
Plates and crushers. 200
242. Hance's mill 201
242*a*. Lower plate 201
242*b*. Upper plate 201
243. Base 201
244. Trituration 202
245. Spiral track of pestle. 202
246. Mortar for trituration 202
247. Pestle (hard rubber handle). . . 203
248. Wedgwood mortar and pestle . . 203
249. Triturating with loaded pestle. . 203
250. Porcelain mortar and pestle. . . 204

FIG. PAGE

251. 252. 253. Solid handle and balanced handle spatulas 204
254. Spatula, blade coated with hard rubber 205
255. Jones's mixer and sifter 205
256. Hunter's sifter 206
257. Enclosed sifter 206
258. Scoop sifter. 206
259. Scoop sifter sieve (end view) . . 206
260. Slab and muller 207
261. Elutriating apparatus 208
262. Trochiscator 208
263. Circulatory solution 213
264. Rice's lysimeter 214
265. Method of absorbing gas 220
266. Wash bottle 220
267. Gas generator. 220
268. Spritz bottle 222
269. Continuous washing 223
270. Continuous washing apparatus . 223
271. Use of the guiding rod 224
272. Syphon diagram. 224
273. Syphon 225
274. Syphon in bottle 226
275. Syphon 226
276. Pattern for Hippocrates's sleeve . 226
277. Strainer, Hippocrates's sleeve . . 226
278. Use of strainer 227
279. Cotton cloth strainer. 227
280. Strainer and frame (tenaculum) . 227
281. Prescription strainer 228
282. Careless straining 228
283. Plain filter 230
284. Double plain filter 230
285. Rother's filter (first step) 230
286. Rother's filter 230
287. Filter 231
288. Folding plaited filter 231
289. Folding plaited filter 231
290. Folding plaited filter 231
291. Folding plaited filter 231
292. Folding plaited filter 231
293. Folding plaited filter. 231
294. Folding plaited filter 231
295. Folding plaited filter 231
296. Folding plaited filter 232
297. Plaited filter 232
298. Plaited filter, parallel folds . . . 232
299. Plaited filter, parallel folds . . . 232
300. Arrangement of funnel in filtration 233
301. Filtering into a bottle (proper method) 233
302. Filtering into a bottle (improper method) 233
303. Plain funnel. 234

FIG. PAGE

304. Ribbed funnel 234
305. Tinned copper funnel 234
306. Hard rubber funnel 235
307. Dispensing counter funnel . . . 235
308. Funnel stand 235
309. Bartlett's funnel. 236
310. Valve funnel 236
312. Hadden's filter 236
313. Hadden's filter (interior) 236
314. Warner's filter 236
315. Filtration of volatile liquids. . . 237
316. Hot filtration 238
317. Jacketed hot water funnel . . . 238
318. Hot filtration (use of coil) . . . 238
319. Hot filtration 239
320. Hot filtration (water bath) . . . 239
321. Rapid filtration 239
322. Lux's aspirator 240
323. Rapid filtration 240
324. Fisher's vacuum pump 240
325. Chapman's pump 241
325*a*. Richards' pump 241
326. Vacuum pump 242
327. International disk filter 242
327*a*. Centrifugal filter 243
327*b*. Centrifugal filter, interior . . . 243
328. Plain pipette 249
329. Syringe pipette 249
330. Pipette (sheet rubber top) . . . 249
331. Separating funnel 249
332. Globe separator 249
333. Pear shaped separator 250
334. Mitchell's separator 250
335. Florentine receiver 250
336. Receiver for light and heavy oils . 250
337. Precipitating jar 253
338. Filter (for precipitates) 253
339. Collecting a precipitate 254
340. Frame and strainer for precipitates. 254
341. Cube 256
342. Octahedron 256
343. Truncated cube 256
344. Truncated octahedron 256
345. Right square or dimetric prism . 256
346. Dimetric octahedron 256
347. Square prism, pyramidal summits 256
348. Square prism, pyramidal summits 256
349. Rhombic prism 256
350. Rhombic octahedron 256
351. Rhombic prism, pyramidal summits 256
352. Rhombic octahedron (partially truncated) 256
353. Hexagonal prism 257
354. Double hexagonal pyramid . . . 257

FIG. PAGE

355. Hexagonal prism (truncated) . . 257
356. Hexagonal prism, pyramidal summits 257
357. Monoclinic prism 257
358. Monoclinic octahedron 257
359. Monoclinic prism (partly truncated) 257
360. Monoclinic prism, pyramidal summits 257
361. Triclinic prism 257
362. Triclinic octahedron 257
363. Triclinic prism (truncated) . . . 257
364. Triclinic octahedron (partly truncated) 257
365. "Growing" crystals 259
366. "Growing" crystals 259
367. Appert glass tank 261
368. Oven for drying granulated effervescent salts 264
370. Dialyzer 266
371. Dialyzer 267
372. Dialyzer (glass) 267
373. Circulatory maceration 269
374. 375. Gigot's press. 271
376. Troemner's press 272
378. German single screw press . . . 272
379. Enterprise press 273
380. Enterprise press 274
381. George's double screw press . . 274
382. Wedge press 275
383. Wedge press (end view) 275
384. Hydraulic press 276
385. Dudgeon's press. 277
386. Centrifuge (under driven) . . . 278
387. Centrifuge (over driven) 278
388. Official percolator 282
389. Official percolation 282
390. Plain percolator 284
391. Oldberg's percolator 284
392. Conical percolator 284
393. Narrow percolator (200 Gm. of powder) 284
394. Ordinary percolator (200 Gm. of powder) 284
395. Conical percolator (200 Gm. of powder) 284
396. Pan for moistening powders . . 285
397. Notched cork 286
398. Scored paper 286
399. Packer 287
400. Imperfect packing 287
401. Proper packing 287
402. Percolating weight 288
403. Sheet rubber cover 288
404. Sprinkler controller 290

FIG.		PAGE
405.	Dursse's percolator	290
406.	Well tube percolator (Squibb)	290
407.	Appert glass well tube percolator	292
408.	Double tube percolator	292
409.	Suspended percolator (Hance's)	293
410.	Copper percolator (Colton)	294
411.	Hardesty vanilla percolator	294
412.	Copper percolator	294
413.	Pressure percolator (Suits)	295
414.	Lewin's extraction apparatus	296
415.	Percolator stand	296
416.	Percolation closet (Shinn)	297
417*a*.	Receiving flask	297
417*b*.	Receiving bottle	297
418.	Receiving bottle (all glass)	297
419.	Hardesty syrup percolator	319
430.	Alsop's infusion jar	450
431.	Squire's infusion mug	450
432.	Infusion pitcher	450
433.	Infusion mug (home-made)	450
434.	Infusion bottle	453
435.	Block tin decoction vessel	456
436.	Brass water bath	456
437.	Beck's continuous percolation method	525
438.	Needles's vacuum percolator	526
439.	Percolator for volatile liquids	598

PRACTICE OF PHARMACY

INTRODUCTORY

THEORETICAL AND PRACTICAL PHARMACY

PHARMACY is the science which treats of medicinal substances. It comprehends not only a knowledge of medicines and the arts of preparing and dispensing them, but also their identification, selection, preservation, combination, and analysis.

The word Pharmacy is also used to designate the place where medicines are sold.

For convenience in study, Pharmacy may be divided into two great classes,—viz., *Theoretical Pharmacy* and *Practical Pharmacy.*

Theoretical Pharmacy.—Inasmuch as all Nature, animate and inanimate, has been laid under contribution to provide remedies for the alleviation of disease, it follows that those sciences which embrace a knowledge of substances obtained from the vegetable, mineral, and animal kingdoms, as well as those which treat of the laws governing them, are called upon to furnish important facts which form the basis of the science of Pharmacy.

Botany, the science of plants, *Mineralogy*, that of inorganic substances found in or on the earth, and *Zoölogy*, the science which treats of animals, are, however, less important than *Chemistry* and *Physics;* for upon these two Pharmacy is most dependent for its greatest development and its highest degree of usefulness.

Physics or *Natural Philosophy* is that branch of science which describes and explains the changes produced in bodies, by which their specific identity is not destroyed, while *Chemistry* treats of those changes which affect the specific identity of the bodies.

Materia Medica (medicinal materials) is a term applied to designate the substances which are used in the cure of diseases; it is most intimately connected with *Pharmacognosy*, the science which treats of crude drugs, while the specific definition of Pharmacy limits the latter to the consideration of the preparations made from drugs.

In colleges of pharmacy, as well as in universities where pharmacy is a part of the instruction, it is usual to divide General Pharmacy into three departments,—Chemistry, Botany and Materia Medica, and Theory and Practice of Pharmacy.

Toxicology, the science of poisons, *Microscopy*, which requires the use of optical instruments called microscopes, *Bacteriology*, a natural science which treats of micro-organisms, and *Serology*, dealing with serum products, form valuable collateral and special subjects of study.

Pharmacology is broadly defined as the science of drugs. Unfortunately the name has been limited by specialists to the action of drugs on living organisms.

Practical Pharmacy is that branch of Pharmacy which treats of the operations, processes, and methods used in applying the principles of theoretical pharmacy.

PHARMACOPŒIAS AND DISPENSATORIES

A *pharmacopœia*, in the modern acceptation of the word, is a book containing a list of medicinal substances, with descriptions, tests, and formulas for preparing the same, selected by some recognized authority. The necessity for legalized standards to define the character, establish the purity, and regulate the strength of medicines is recognized by all civilized nations; and although all of the nations of the globe have not yet formally adopted national standards, in nearly every case where this has not been done it will be found that the standards of some other country are in use. The most important pharmacopœias, with the dates of their latest issues, are as follows:

Official Pharmacopœias

Nation	Date of Issue	Title
1. United States	1916	Pharmacopœia of the United States of America, Ninth Decennial Revision[1]
Spanish Edition To Appear	1917	
2. Great Britain and Ireland and Colonies	1914	British Pharmacopœia combining the Indian and Colonial Addendum
3. Germany	1910	Arzneibuch für das Deutsche Reich (Pharmacopœa Germanica, editio V)
4. France	1908	Codex Medicamentarius Gallicus (Pharmacopée Française)
5. Austria	1906	Pharmacopœa Austriaca, editio octava
6. Belgium	1906	Pharmacopœa Belgica, editio tertia
7. Chili	1886	Farmacopea Chilena
8. Croatia-Slavonia	1888	Pharmacopœa Croatico-Slavonica
9. Denmark	1907	Pharmacopœa Danica
10. Greece	1899	Ἑλληνική Φαρμακοποιία
11. Hungary	1909	Pharmacopœa Hungarica, editio tertia
12. Italy	1909	Farmacopea ufficiale del regno d'Italia, terza edizione
13. Japan	1906	Pharmacopœa Japonica
English Edition	1907	
14. Mexico	1904	Nueva Farmacopea Mexicana, cuarta edición
15. Netherlands	1905	Pharmacopœa Nederlandica, editio quarta
16. Norway	1913	Pharmacopœa Norvegica, editio quarta
17. Portugal	1876	Pharmacopœa Portugueza
18. Roumania	1893	Pharmacopœa Romana
19. Russia	1910	Pharmacopœa Rossica, sixth edition
20. Servia	1908	Pharmakopœa Serbica, editio secunda
21. Spain	1905	Farmacopea Oficial Española, séptima edición
22. Sweden	1908	Pharmacopœa Suecica (Svenska Farmakopén)
23. Switzerland	1907	Pharmacopœa Helvetica, editio quarta
24. Venezuela	1898	Farmacopea Venezolana, I
25. Argentina	1898	Ph. Arg. I, Farmacopea Nacional Argentina, primera edición
26. Finland	1914	Ph. Fenn. V, Pharmacopœa Fennica, editio quinta

[1]In quoting this title, it is customary to abbreviate it to "U. S. P. IX." It is advisable to adhere to this form so as to preserve uniformity. The "ninth revision" means, of course, the same as "tenth edition." Formerly it was customary to use the year in which the Decennial Convention met to designate the Pharmacopœias, thus "U. S. P. 1890"; much confusion resulted from this practice because it now requires three or four years to revise such an authority and hence the "U. S. P. 1890" would have been more appropriately termed the "U. S. P. 1893." In the last two revisions this was corrected by omitting a date upon the back of the book and using the words "Eighth Decennial Revision" and "Ninth Decennial Revision."

The U. S. Pharmacopœia is now used officially in Porto Rico and the Philippine Islands and has been recognized as the official Pharmacopœia of Cuba, every drug store in Cuba since 1910 having been compelled by law to have a copy. A Spanish Edition of the U. S. P. VIII was issued in 1909 and a Spanish Edition of the U. S. P. IX has been authorized and is in course of preparation. Central and South American countries are now using the Spanish U. S. Pharmacopœia. In the West Indian Islands, where French and Spanish are the principal languages, the most generally used, unofficial work of reference is Dorvault's "L'Officine," an extensive commentary and supplement to the French Pharmacopœia.

BOLIVIA.—French, Spanish, and Chilian Pharmacopœias.
BRAZIL.—French, Portuguese, and Spanish Pharmacopœias. Also (not official) Formulario ou Guia Medica, etc. By P. L. N. Chernovitz. Novo Formulario medico e pharmaceutico, ou Vademecum Medicum. By Th. J. H. Langgaard.
CENTRAL AMERICAN STATES.—French, Spanish, and Mexican Pharmacopœias. Also, to some extent, the British and that of the United States.
CHINA.—The native druggists and herbalists still regard as their chief authority the old Chinese Encyclopedia of natural history, entitled Pen-tsao-kang-mu, composed by Li-shi-chin between 1552 and 1578. The usual editions of this work are printed in 40 thin volumes, 8vo. Foreign pharmacists use the pharmacopœias of their respective countries. The British is most in use.
CUBA.—The United States Pharmacopœia (Spanish Edition) since 1910.
ECUADOR.—French and Spanish, also several foreign pharmacopœias.
HAITI.—French and Spanish Pharmacopœias (chiefly).
HAWAIIAN ISLANDS.—Chiefly the United States Pharmacopœia. To some extent, also, the British and the German.
LIBERIA.—The United States Pharmacopœia (chiefly).
PERU.—The French, Spanish, British, and United States Pharmacopœias.
TURKEY.—The French Pharmacopœia.
URUGUAY.—The French and Spanish Pharmacopœias. Occasionally, also, the British and that of the United States.

The official pharmacopœias are all issued under the authority of the respective governments, with the exception of the United States Pharmacopœia, which has, however, been accepted by the government and the individual States, through the National and State Pure Food and Drugs Acts. Efforts are constantly being put forth to secure the adoption of an International Pharmacopœia. If these should prove successful, a great advance will be made in bringing about a uniformity in the strength of preparations; yet it may well be doubted whether such a work would be as generally useful as the pharmacopœias at present in use, which have been proved by long experience best adapted to the varying needs of the different nations. A practical plan of securing the chief advantages possessed by an International Pharmacopœia has been inaugurated by the establishment of the "International Conference for the Unification of Potent Remedies," which met in the City of Brussels in September, 1902. This body in the final *protocol* agreed upon standards of strengths for potent preparations which they expect the various pharmacopœias of the world to adopt. In 1906, representatives from nineteen governments met at Brussels and with certain reservations formally signed the agreements drawn up in 1902 and also formulated details for further unification. The United States Pharmacopœia (eighth revision) was the first national pharmacopœia to adopt some of these recommendations. The U. S. P. IX has inserted the Latin title adopted by the International Conference, followed by the letters "P. I.," below the official title of those preparations which conform to the standards of the protocol. The letters P. I. mean "Protocol Internationale."

The Pharmacopœia of the United States, Ninth Decennial Revision, was prepared by a committee appointed by the National Convention of 1910 for revising the Pharmacopœia, which met in Washington, D. C., May 10, 1910. Seventy-six medical bodies, seventy-five incorporated pharmaceutical organizations and the American Chemical Society, the Association of Official Agricultural Chemists, the Association of State and National Food and Drug Departments, the Surgeon-General's Office of the United States War Department, the Bureau of Medicine and Surgery of the United States Navy Department, the Bureau of Public Health and Marine Hospital service of the United States Treasury Department and the United States Department of Agriculture sent delegates to this convention, which selected from those present fifty members, with the President of the Convention a member *ex officio*, making the total fifty-one, and these were designated as the "General Committee of Revision of the Pharmacopœia of the United States of America." Of this number thirteen were physicians, twenty-six were pharmacists and chemists, nine were chemists, and three botanists and pharmacognosists. At the Eighth Decennial Convention, in 1900, several important changes in the plan of the work were made, the business portion was separated from that of actual revision by creating a Board of Trustees whose duty is to make contracts, attend to the finances, and place the book on sale. The Convention was also incorporated at that time, and it now carries on its work under a charter issued at Washington under the laws of the District of Columbia. The Convention of 1910 changed the number of members on the Committee of Revision from twenty-six to fifty-one and also authorized the formation of an "Executive Committee," to be elected from the larger or "General Committee," this smaller committee to have immediate charge of the work of revision; in this way it was believed that decisions might be arrived at more readily and the revision facilitated. The General Committee of Revision, as soon after their election as possible, met, elected officers, and the chairman organized the work of revision, appointing fifteen sub-committees to report upon the several divisions of the work. These were: 1. Scope, 2. Therapeutics, Pharmacodynamics, and Posology, 3. Biological Products and Diagnostical Tests, 4. Botany and Pharmacognosy, 5. General and Inorganic Chemistry, 6. Organic Chemistry, 7. Proximate Assays, 8. Volatile Oils, 9. Fluid and Solid Extracts and Tinctures, 10. Aromatic Waters, Spirits, and Liquors, 11. Syrups and Elixirs, 12. Cerates and Ointments, 13. Miscellaneous Galenicals, 14. Tables, Weights and Measures, and 15. Nomenclature.

When these appointments were ratified by the General Committee of Revision and Board of Trustees, each sub-committee organized and elected its own Chairman.

These sub-committee Chairmen, through appointment by the General Chairman and election by the General Committee, formed the "Executive Committee of Revision," with the Chairman of the General Committee also as Chairman of the Executive Committee and the actual work of revision began. According to the By-laws of the Convention, the "Executive Committee shall execute such orders or resolutions as have been assigned to it by the Convention, the General

Committee of Revision or the Board of Trustees, and have entire charge of the preparation of the manuscript and reading of proof for the revised Pharmacopœia." The General Committee of Revision represent geographically various parts of the United States, and it is necessary to conduct the revision by mail communications, which are voluminous. The Board and Committee remain in office until the next decennial convention meeting, or until their successors are appointed. Permission to use the text of the Pharmacopœia is granted upon application to the Chairman of the Board of Trustees under certain regulations which are necessary to guard the copyright. As the U. S. Pharmacopœia will be largely quoted in this treatise, its plan and the outlines of its main features should be thoroughly understood at the outset.

Nearly one thousand substances (782), embracing crude drugs and preparations, have been deemed of sufficient importance to merit a place in the U. S. Pharmacopœia.

Under the Food and Drugs Act, the United States Pharmacopœia and the National Formulary are now the law of the land. Their standards are obligatory and violations are now punishable by fine or other penalty.

Nomenclature

The names of the various substances are indicated—1. By the OFFICIAL LATIN TITLE, which is always in the Latin language. 2. By the OFFICIAL ENGLISH TITLE. 3. By the ABBREVIATED TITLE. 4. By the SYNONYM. 5. By the BOTANICAL NAME (in the case of plants). 6. By the SYMBOLIC FORMULA (in the case of chemicals). Each of these names has a special use.

The following extracts from the Pharmacopœia are given in illustration:

CANTHARIS	[Official Latin title]	**UNGUENTUM PHENOLIS**
Cantharides	[Official English title]	**Ointment of Phenol**
Canthar.	[Official Abbreviated title]	**Ung. Phenol.**
[SPANISH FLIES, RUSSIAN FLIES]	[Synonym]	[OINTMENT OF CARBOLIC ACID]
POTASSII BITARTRAS	[Official Latin title]	**SPIRITUS ÆTHERIS**
Potassium Bitartrate	[Official English title]	**Spirit of Ether**
Pot. Bitart.	[Official Abbreviated title]	**Sp. Æth.**
[CREAM OF TARTAR]	[Synonym]	[HOFFMANN'S DROPS]
$KHC_4H_4O_6$ (188.14)	[Symbolic formula]	

1. **The Official Latin Title.**—Example, **LIQUOR AMMONII ACETATIS.** The official Latin title is thoroughly distinctive, and is intended to be used in designating the drug or preparation where precision is required, and is used, usually in its abbreviated form, in writing prescriptions, in labelling store furniture, specimens, etc. Latin is selected for the official title because it is universally used and understood as the "language of science," and is not liable to change, as is the case with a living tongue. Although the official titles are usually abbreviated in practice, the proper terminations and full titles should be known and observed carefully, and the habit of using the Latin

abbreviations in English conversation strictly guarded against as not only inelegant, but vulgar.[1] A vast amount of careful consideration, extending over many years, has been expended in perfecting a system of pharmacopœial nomenclature which is at once "brief, simple, expressive, distinctive, and convenient." The following may be cited as models: Acacia, Camphora, Opium, Rheum, Sapo, etc., the full pharmacopœial definition of these titles being, respectively, **Acacia.** "The dried gummy exudation of *Acacia Senegal* Willdenow, and of other African species of *Acacia* (Fam. *Leguminosæ*)." **Camphora.** "A ketone [$C_{10}H_{16}O$ or $C_9H_{16}CO = 152.13$] obtained from *Cinnamomum Camphora* (Linné) Nees et Ebermaier (Fam. *Lauraceæ*); it is dextrorotatory." **Opium.** "The air-dried milky exudation obtained by incising the unripe capsules of *Papaver somniferum* Linné and its variety *album* De Candolle (Fam. *Papaveraceæ*), and yielding, in its normal, moist condition, not less than 9.5 per cent. of anhydrous morphine." **Rheum.** "The rhizome and roots of *Rheum officinale* Baillon, *Rheum palmatum* Linné, and the var. *tanguticum* Maximowicz (Fam. *Polygonaceæ*), and probably other species of *Rheum* grown in China and Thibet, deprived of most of the bark tissues and carefully dried." **Sapo.** "Soap prepared from olive oil and sodium hydroxide." The *generic*, or genus name (the first part of the botanical name), was generally chosen for the official Latin title, as, **Pilocarpus,** for "the leaflets of *Pilocarpus Jaborandi*" (botanical name). In the case of some old and very well-known drugs, this rule could not be adopted without causing confusion and the *specific* or species name (the second part of the botanical name) was retained, as **Ipecacuanha,** the official Latin title for "the dried root—of *Cephaelis Ipecacuanha.*" The official Latin title obviously cannot retain the simplicity of a single word where two parts of the same plant are official. Thus, for example, the corm and seed of Colchicum must each be defined by affixing the Latin name of the particular part of the plant intended, as *Colchici Cormus* for Colchicum Corm, and *Colchici Semen* for Colchicum Seed; nor can a single word be chosen for either official title where the specific names of two or more plants of the same genus differ. The generic name of the two official mints is Mentha, and to distinguish them it is necessary to use the full botanical name for each. Thus, the *Mentha piperita* (Peppermint), *Mentha Viridis* (Spearmint).

There are a very few exceptions to the above principles of nomenclature, as in the case of *Kino* and *Prunus Virginiana*, derived, according to the most recent and reliable authorities, respectively from *Pterocarpus Marsupium* and *Prunus serotina*. These drugs are largely used, and the old names have become so well established that it would lead to confusing and possibly embarrassing mistakes to change them now. The Latin names are generally used in the singular number, although the definition of the drug distinctly indicates plurality; for instance, *Galla* is the official name for nutgalls, as they are termed commercially, and is in the nominative singular (plural, *Gallæ*). The official definition, however, reads "Excrescences on the young twigs of *Quercus infectoria* Olivier, etc." *Caryophyllus* (nominative singular) is the official name

[1] Example of what should be avoided in conversation: "I mixed the *Pulv. Pip. Nig.* with the *Pot. Carb.* and the *Muc. Trag.*, but could not form a mass."

for the dried flower-buds of Clove. The reason assigned in the preface to the U. S. Pharmacopœia, 1850, for this apparent deviation, is that "the example of the Roman medical writers, particularly of Celsus, might be followed." In the case of compound medicines, such official titles were selected as would usually express the composition of the preparations as fully as possible, indicating the principal ingredients without sacrificing the important consideration of brevity and convenience in abbreviation, as Mistura Cretæ, Pulvis Ipecacuanhæ et Opii, and Tinctura Opii Camphorata. In some cases it is desirable to indicate in the title the medical properties or use of the preparation, as in Pilulæ Catharticæ Compositæ, Serum Antidiphthericum. Where the number of important ingredients in a preparation is too great to admit of a selection, the participial adjective *compositus* (meaning compound) is added, the feminine (*composita*) or neuter (*compositum*) termination being used respectively where the noun is feminine or neuter, as Spirit*us* Juniperi Composit*us* (masc.), Tinctur*a* Lavandulæ Composit*a* (fem.), Extract*um* Colocynthidis Composit*um* (neut.).

2. **The Official English Title.**—Example, **Solution of Ammonium Acetate.** This name should be used when the drug or preparation is mentioned in ordinary conversation, in commercial transactions, in writing orders for supplies, and in all cases where the use of the Latin official title could be justly criticized as an ostentatious display of erudition. In the U. S. Pharmacopœia, 1880, a large number of English titles used in former Pharmacopœias were changed, the old vernacular names being either dropped altogether or inserted as synonyms. This advanced step was rendered necessary by the increase in articles used in the materia medica and by a desire for greater accuracy and better methods in nomenclature. The confusion which always exists in different localities concerning the common names of drugs is also avoided, as the anglicized Latin name is distinctive. The former English names *Bloodroot, Calabar Bean, Male Fern,* and *Yellow Jasmine,* for instance, are replaced by *Sanguinaria, Physostigma, Aspidium* and *Gelsemium.*

On the other hand, some of the common English names were so fixed by usage that it was not deemed judicious to alter them; besides, to have changed them would have often substituted a longer and less convenient word. The retention of the English names *Clove, Hops,* and *Ginger* sufficiently illustrates this.

In the U. S. Pharmacopœia, 1890, a very important change was made in the English names of the chemical substances, the basylous or metallic component being given the first place; for instance, *potassium citrate, ammonium bromide,* and *zinc sulphate,* replace the former names *citrate of potassium, bromide of ammonium,* and *sulphate of zinc.* This change required many alterations in nomenclature, but it was a necessary step for the Committee of Revision to make the names accord with the established usage of the best modern chemical writers. In the U. S. P. 1890 the salts of iron and mercury were for the first time differentiated by the use of the terms *ous* and *ic* respectively to designate lower and higher forms of the salts; for example, ferr*ous* sulphate and ferr*ic* sulphate, mercur*ous* iodide and mercur*ic* iodide, replaced the names sulphate of iron and iodide of mercury; the compounds of

mercury, on account of the differences in dose existing among them, were further distinguished by the use of the adjectives "corrosive," "mild," "red," "yellow." For the scale salts of iron, which are of complex composition and not true chemical salts, notwithstanding the fact that the metallic component exists in them in the ferric state, the term "iron" was used in order to emphasize the fact of their defective chemical construction, for they are not definite double salts. This nomenclature was retained in the Ninth Decennial Revision of the Pharmacopœia.

The Pharmacopœial names of chemical substances do not always represent their chemical composition. The enormous multiplication of synthetic remedies, and the length of the systematic names of these bodies, have compelled the use of shorter terms which are more conveniently employed in prescriptions and in commercial transactions. Thus, "metadihydroxybenzene" is a more cumbersome word than "resorcinol," "phenyldimethylpyrazolon" than "antipyrine." If we turn to unofficial substances, a better example is afforded by the use of "analgen," which is dignified by the systematic name of orthoethyloxyanamonobenzoylamidochinoline." In the Eighth Revision and also in the Ninth it was necessary to introduce quite a number of synthetic remedies having long scientific names, and trade or proprietary names could not be used as titles in a standard book of this character, hence the long names had to be shortened, and "diethylsulphonedimethylmethane" became "sulphonmethane," "2-phenyl-quinoline 4 carboxylic Acid" became "Phenylcinchoninic Acid," and "Quarternary oxymethyl oxymethelene dihydro isoquinoline chloride" became "Cotarnine Hydrochloride." The value of a long chemical name lies in the fact that the name indicates its composition, but some of the most useful modern remedies are very complex in their chemical composition, hence the inconvenience. The custom of abbreviating the official Latin titles in writing prescriptions is universal among physicians, and the new official names, which are long, will not cause great inconvenience in practice. Thus "Hexamethylenamina" has been abbreviated to "Hexam."

3. **Abbreviations.**—The U. S. Pharmacopœial Convention of 1910 recommended that there should be inserted, after each article used by physicians in prescriptions, a carefully considered abbreviated name, which may be known as an official abbreviation, in order that uniformity may be established throughout the country, with the object of preventing mistakes in reading and compounding prescriptions, and, further, to serve as authorized abbreviations in labelling the store furniture of the pharmacist. Such abbreviated titles have been provided in the U. S. P. IX, the N. F. IV, and the British Pharmacopœia (1914).

4. **The Synonym.**—Example, [Basham's Mixture]. In the Pharmacopœia the definition of the term synonym is restricted to an equivalent name in common use, which is usually antiquated and derived from an unscientific source, and which should really be abandoned, but which common custom and long usage demand shall not be entirely ignored. The synonyms should be rarely or never used, yet it is necessary for the student to be familiar with them in order to recognize their

equivalent official Latin or English names when they are used by others. Common names, as snakeroot, dock, Indian hemp, balm, etc., have varying and often opposite meanings in different localities, and confusion and even loss of life have resulted from the unfortunate use of these common names. In the U. S. P. IX synonyms are placed below the official English title in smaller type. In the U. S. P. VIII synonyms had been placed in the index under the official Latin titles, but the increased importance of synonyms after the passage of the Food and Drugs Act, when synonyms were sometimes used to evade the standards, led the Convention of 1910 to recommend that the list be enlarged and be printed in the text of the Pharmacopœia immediately after the English name of the substance. The Committee of Revision also passed the following resolution which had been adopted by the Convention: "Substances labelled with an official synonym must comply with the standards, tests and requirements demanded for the official article."

5. **The Botanical Name.**—By this is meant the systematic name recognized by botanists for plants, which serves in pharmacopœial nomenclature as the basis of the official name. The botanical name usually consists of two Latin words, the first indicating the genus and the second the species to which the plant belongs. *Capsicum frutescens* is the botanical name for the particular variety of capsicum or Cayenne pepper which the Pharmacopœia designates. Here the generic, or first name, is chosen for the official title, and if no description followed the title it would be inferred that any part of any plant in the genus "Capsicum" could be officially used for making preparations; but the specific name, "frutescens," limits the use to this species, while the description which follows shows the *part* of the plant which must be employed: "the dried, ripe *fruits* of *Capsicum frutescens* Linné (Fam. *Solanaceæ*) without the presence or admixture of more than 2 per cent. of stems, calyxes, or other foreign matter." Now, Capsicum baccatum and Capsicum annuum belong to different species and are active members of the genus, but their claims are unrecognized, and the fruit from these species is not official. The specific name does not begin with a capital letter, except when it has been at some previous time itself a generic name, as in Rhamnus Frangula, or when it is derived from the name of a person, as in Garcinia Hanburii, or when the word is indeclinable, as in Theobroma Cacao, or when it is a combination of a noun and an adjective, as in Xanthoxylum Clava-Herculis. The name of the author follows the botanical name, as, *Capsicum frutescens* Linné, and after this the Family [1] to which the plant belongs is indicated in italics, and the whole enclosed in parentheses, as (Fam. *Solanaceæ*). The term Natural Order (Nat. Ord.) was replaced in the U. S. P. (VIII) by the word Family (Fam.), to accord with modern usage among botanical authorities. It must be apparent that the botanical name need not be employed either in writing or speaking in ordinary pharmaceutical work; but its use is absolutely necessary in establishing the identity of any drug authorized by the Pharmacopœia, and hence it is important to know the botanical names.

6. **The Symbolic Formulæ.**—The adoption of certain arbitrary symbols [2] to represent chemical elements leads to a most convenient and

[1] See index for chart of drugs arranged according to the Families.
[2] See index for table of elements, with symbols and atomic and molecular weights.

useful application, whereby the composition of a chemical is expressed with the utmost brevity and exactness. Plumbi Oxidum and Lead Oxide are both much longer terms than "PbO," and not so definite. *Sodium Sulphate* does not always contain the same proportion of water of crystallization, and if the symbolic formula, $Na_2SO_4+10H_2O$, were not appended to the official title there might be some doubt about which sulphate was intended; the added $10H_2O$, however, accurately defines it. The *figures* which follow the symbolic formulas indicate the *molecular weight* (the sum of the weight of the atoms) of the chemical. Thus, in $MgSO_4+7H_2O=246.50$, the atomic weight of Magnesium, Mg, 24.32, is the first factor; this added to Sulphur, S, 32.07, makes 56.39; Oxygen, O, 16.00, multiplied by 4, gives 64.00; then Hydrogen having the atomic weight of 1.008, if multiplied by 2 and this by 7, gives 14.112, and seven times O (16.00) is 112.00; then $56.39+64.00+14.112+112.00=246.50$, the molecular weight of magnesium sulphate.

The Official Definition.—In order to have no question arise as to the exact meaning of the official Latin title, or any other name by which an official substance is known, it is necessary to state explicitly in language that can be thoroughly understood what kind or variety of the substance should be used. In the case of drugs this has been already noticed (see page 29); for chemicals an illustration may be given in Guaiacol, which is defined as "the monomethyl ether [$C_7H_8O_2$ or $C_6H_4(OH)(OCH_3)$ 1:2=124.06] of ortho-dihydroxybenzene, obtained from wood-tar creosote or prepared synthetically." Again, Sevum Preparatum, Prepared Suet, is officially defined as "The internal fat of the abdomen of the sheep (*Ovis aries* Linné, Fam. *Bovidæ*), purified by melting and straining." This excludes beef suet and all other kinds, and states the method of purification.

The Purity Rubric.—This was first introduced into the U. S. P. VIII to limit the quantity of innocuous impurities in chemicals, by stating in terms of percentage the amount of pure substance that must be present. It has been continued and extended to drugs and many other articles in the U. S. P. IX. Thus, under Potassii Iodidum, Potassium Iodide, will be found the "purity rubric" as follows: "It contains, when dried to constant weight at 100° C., not less than 99 per cent. of KI (166.02)"; the caution to keep in well-closed containers is added. It might appear, at first sight, that chemicals should always contain 100 per cent. of pure product, but practical experience shows that absolute purity is not attainable without the expenditure of much money, and the presence of minute quantities of impurities (provided that they are harmless) cannot affect the medicinal value of a chemical. Under the pharmacopœias formerly in use, prosecutions were often started, and penalties were imposed by the State authorities, because their was no purity rubric nor allowance for the absorption of moisture or the presence of traces of substances which were innocuous; the purity rubric remedies this defect by definitely stating the amount of permissible impurities. In the case of most vegetable drugs a limit has been fixed for the percentage of foreign matter which will be permitted. In some instances this applies to roots, stems, or seeds of the same plant but usually it is intended to exclude the presence or admixture of foreign substances.

The Official Description.—Immediately following the official definition of the substances there will be noticed in the Pharmacopœia, in smaller type, what has been termed the *official description*; this consists usually, in drugs, of a concise statement of their physical characteristics, when entire, and also, in most instances, the same drug when sectioned or powdered. Tests of identity, ash limits, and other means of determining purity or the presence of adulterants have also been appended. In the chemicals the official definition usually includes the symbolic formulas, and the purity rubric and the official description follow; this is printed in smaller type, exactly as in the case of the drugs; to this description are usually added the solubilities, with tests of identity and purity for the substance.

Assay Processes.—The assaying of chemicals, drugs, oils, and preparations has become necessary in order to definitely fix their value as medicinal agents, and the U. S. P. has introduced many such assays. This work requires skill, knowledge, and experience, and each process requires careful study. When alkaloidal drugs are to be assayed, the process which is usually followed consists of dissolving out the desired active principle, from a fluid preparation representing the drug, with the aid of certain solvents which are capable of extracting the desired constituents but which are not miscible with the liquid that is being assayed, and which may, therefore, be easily separated.

This immiscible solvent, after separation, is carefully treated to purify the substance which it has dissolved, and finally the quantity of the substance is determined by one of two methods: *gravimetric*, in which the solvent is evaporated carefully, the residue weighed, and the percentage present in the original drug calculated from this weight; or the process may be *volumetric*, in which case the amount of alkaloid dissolved is determined by its power to neutralize a standard acid volumetric solution, the amount of solution required being carefully noted, and the percentage of alkaloid calculated from the figure obtained. The method of assay is inserted at the end of the articles. A number of chemical substances, volatile oils, animal products, etc., are also assayed, but for some chemicals it suffices to attach descriptive tests which answer a similar purpose, and in which the strength may be determined without the elaborate preliminary treatment required in drug assays.

The majority of assays for chemicals and volatile oils are of the *volumetric* type in which solutions of known or standard strength are used to produce a characteristic reaction from which the purity or strength of the substance tested may be determined by calculation. *Gravimetric* assay methods, however, are also used where necessary; in these the substance tested is obtained in an insoluble or other weighable form and the purity or strength is determined from its weight by a suitable calculation.

The U. S. P. IX has also introduced *biological* assays for a few drugs or their preparations which cannot be standardized by the usual chemical methods. This form of assay requires a comparison of the physiological action produced upon an animal by a drug of unknown strength with the same drug which has been standardized. The preparation of unknown strength is then adjusted to produce the same action as the standard, in the same dose. This

form of assay applies to Cannabis, Aconite, Digitalis, Strophanthus, Squill, and the Suprarenal glands. The assay for Cannabis and its preparations has been made compulsory but the others are only advisory.

Doses.—An innovation was adopted in the U. S. P. VIII by the insertion of the "Average dose" at the end of the greater number of the articles; this has been continued in the U. S. P. IX. The dose of a medicine can never be a fixed and unvarying quantity; the age and condition of the patient, the severity of the disease, the idiosyncrasy and tolerance for medicines, must all be reckoned with, and it would be a very unwise physician who disregarded these factors. For these reasons, an "average dose" was used in order to furnish a guide to pharmacists and physicians. The following quotation from the preface of the Pharmacopœia is appended:

"The Convention instructed the Committee 'to state the average approximate (but neither a minimum nor a maximum) dose for adults, . . . the metric system to be used, and the approximate equivalent in ordinary weights or measures inserted in parentheses,' and the Committee was further directed to make the following distinct declaration *'that neither this Convention nor the Committee of Revision created by it, intends to have these doses regarded as obligatory on the physician or as forbidding him to exceed them whenever in his judgment this seems advisable.'*"

Pharmacopœial Illustrations.—The following examples are selected from the U. S P. IX.

CINCHONA	[Official Latin title]	**SODII HYDROXIDUM**
Cinchona	[Official English title]	**Sodium Hydroxide**
Cinch.	[Official Abbreviation]	**Sod. Hydrox.**
Yellow Cinchona Calisaya Bark Yellow Peruvian Bark	[Synonyms]	Caustic Soda Sodium Hydrate
The dried bark of *Cinchona Ledgeriana* Moens . . . yielding not less than 5 per cent. of the alkaloids of Cinchona.	[Official definition and Purity Rubric]	It contains not less than 90 per cent. of NaOH (40.01). [Symbolic formula and Purity Rubric]
In quills or curved pieces of variable length, bark from 3 to 5 mm. in thickness, . . . odor faintly aromatic; taste very bitter and somewhat astringent.	[Official description]	Sodium Hydroxide occurs as dry, white, or nearly white, fused masses, or sticks, hard and brittle, showing a crystalline fracture; odorless, . . . Exposed to the air it . . . absorbs carbon dioxide . . .
The powder is reddish-brown; bast-fibers spindle-shaped, . . . sphenoidal micro-crystals of calcium oxalate numerous.		
	[Tests]	One Gm. of Sodium Hydroxide dissolves in 0.9 mil of water at 25° C. . . . very soluble in alcohol.
Heat 1 Gm. of powdered cinchona in a dry test tube; a tarry distillate forms, having a purplish color and a somewhat granular appearance.	[Test]	An aqueous solution . . . does not respond to the Test for heavy metals.
	[Assay]	
Introduce 5 Gm. of Cinchona . . . into a 500-mil flask and add 200 mils of a mixture of chloroform, 1 volume, and ether, 2 volumes. . . . dry the residue to constant weight. The weight will be the amount of total alkaloids from 4 Gm. of Cinchona.		Dissolve in a 500-mil graduated flask about 10 Gm. of Sodium Hydroxide, accurately weighed . . . and titrate 100 mils of the clear filtrate with normal hydrochloric acid V. S. It shows not less than 90 per cent. of NaOH.
Average dose.—Metric, 1 Gm.—Apothecaries, 15 grains.	[Dose]	
Fluidextractum Cinchonæ, Tinctura Cinchona	[Preparation]	Liquor Sodii Hydroxidi.

The Preparations of the Pharmacopœia

Although these will be considered in detail in the body of this work, a few general remarks on them will be appropriate here. The "parts by weight" plan adopted by the U. S. Pharmacopœia, 1880, was dropped in the 1890 revision, and the "solids by weight, liquids by measure" principle accepted. This is more in accord with the methods used in English speaking countries. A great advance was made by the adoption of the metric system for expressing the quantities, which were thus also made definite. Every pharmacist should employ the metric system exclusively in making preparations; but on account of the revolutionary changes made necessary by the adoption of this system of weights and measures, corresponding quantities are given in the working formulas in this book, which are based on the old system of avoirdupois weight and apothecaries measure. The latter will be found much less convenient than the metric quantities, especially if the operator has procured a set of metric weights and measures and has used them a few times.

The U. S. P. official text is printed in this book by authority from the Board of Trustees of the United States Pharmacopœial Convention, and the official processes are designated by an asterisk (*), printed before the name of the first ingredient, when alternative or "old form" quantities are given. The latter are enclosed in brackets in the text, and are printed in smaller type in the list of ingredients. The object of this arrangement is to indicate that the alternative or old form quantities are not used in the Pharmacopœia.

The old form quantities are not intended to be equivalents of the metric quantities and the two systems are not interchangeable; either "metric" or "old form" may be used, but in no case part of one and part of the other; different type distinguishes one from the other.

National Formulary

The Third Edition of the N. F. was made a standard under the Pure Food and Drugs Act, June 30, 1906, and the Fourth Edition, published in 1916, has been printed in this book, authority being granted by the Council of the American Pharmaceutical Association, as the National Formulary is the property of that organization. Its origin dates from 1882 when Charles Rice, Ph.D., organized a Committee from New York and Brooklyn to frame a book of formulas for unofficial preparations. The New York and Brooklyn Formulary was subsequently enlarged and the joint Committee presented it to the American Pharmaceutical Association in 1885 as the nucleus for the construction of the National Formulary. The book has gone through four Editions and is quoted in the National and State laws as of equal authority with the Pharmacopœia.

The National Formulary IV has been carefully revised (1916) and its standards are in harmony with those of the U. S. P. IX. Its position is secondary and it follows the lead of the Pharmacopœia. Some of the preparations of the Pharmacopœia which were deleted are now found in the National Formulary because physicians continue to use such preparations. On the other hand, some of the preparations of the former edition of the National Formulary have been transferred to the U. S. Pharmacopœia IX.

In the National Formulary the standards of the U. S. P. IX are used; thus, where alcohol, glycerin, syrup, iodine, tincture of opium, cinchona, and other U. S. P. drugs and preparations are directed, it means that such must conform in strength and tests to the standards of the U. S. P. IX.

It is important to remember that if a drug or preparation is sold under or by a name recognized in the U. S. Pharmacopœia or National Formulary it must not differ from the standard of strength, quality or purity determined by the tests laid down in either of these books official at the time of investigation. A drug or preparation is not deemed to be adulterated if it differs from the official standards, provided such standards be plainly stated upon the bottle, box or container.

This position of the National Formulary made it desirable that it should be used in this book so that the student would become familiar with the preparations of both standard books and recognize that they are of equal importance before the law.

Dispensatories

A dispensatory is a commentary on a pharmacopœia. The U. S. Pharmacopœia describes the drugs and chemical substances of the materia medica, establishes the degree of purity of many of them and defines the strength of the preparations. The dispensatories comment on the substances, giving their physical, medical, and pharmaceutical history, with their doses and uses. The number of substances noticed in the Pharmacopœia is limited. On the other hand, the dispensatories present information about those which are official in our own and other pharmacopœias, and those which are of occasional or rare use, in addition. There are at present two dispensatories which comment especially upon the materia medica and preparations of the U. S. Pharmacopœia,—the United States Dispensatory, which was first published in 1833, and the National Dispensatory, which was first issued in 1879. King's American Dispensatory, adopted by the National Eclectic Medical Association in 1879 as its standard authority, is especially designed for the use of Eclectic practitioners. The plans of these works are similar. The text of the Pharmacopœia is first inserted, and immediately following are appended the comments of the authors and editors. The arrangement of the subjects is strictly alphabetical, the United States Dispensatory dividing them, however, into two classes, distinguished by type of two sizes. The principal portion of the work, that in the larger type, is devoted to a commentary on the preparations of the United States and other Pharmacopœias; the unofficial and less important subjects are to be found in the second part. In the National Dispensatory the unofficial substances are considered either in the body of the book or under sub-divisions as allied drugs. The possession of a reliable commentary upon the Pharmacopœia is a *necessity* which is fully realized by pharmacists. The United States Dispensatory is now preferred as a guide, and hence will be frequently quoted.

These questions are intended to aid students in reviewing their work and as suggestive to Boards of Pharmacy in preparing examination questions.

QUESTIONS ON INTRODUCTORY CHAPTER

Define Pharmacy. (See page 25.)
In what respects is Pharmacy an art as well as a science, and what does it comprehend?
Is the word Pharmacy ever applied to any particular place? If so, how?
Into what two classes is Pharmacy divided?
Name and define the sciences which form the basis of Theoretical Pharmacy.
Define Materia Medica.
What is the name of the science which treats of crude drugs?
In what respect does this science differ from Pharmacy in its specific sense?
What is Toxicology?
Of what does Microscopy treat?
Name and define additional collateral branches taught in association with Theoretical Pharmacy.
Define Practical Pharmacy.
What is a Pharmacopœia?
Give the titles and last dates of issue of four of the most important Pharmacopœias.
Why is the present Pharmacopœia called "Ninth Revision" and not "1910"?
What Pharmacopœia is largely used in Porto Rico, the Philippines, Cuba, and many countries of Central and South America?
Are all Pharmacopœias issued under direct authority of government?
If not, name an exception.
What would be the advantages of an International Pharmacopœia?
By what practical plan have the chief advantages of such a book been secured?
What is meant by the letters "P. I." following a title?
When was the present U. S. Pharmacopœia prepared?
Describe the way in which the U. S. Pharmacopœia is revised and how the committees are appointed.
How many members constituted the general committee of revision? How many in the executive committee of revision? What are the duties of the executive committee?
How many substances having separate titles are contained in the Pharmacopœia?
What classification or arrangement of the various drugs and medicines has been accepted?
In the nomenclature of the Pharmacopœia, how are the titles of the various substances indicated?
What is the official Latin title of Spirit of Ether?
What is its synonym?
What is the official English title of Cantharis?
What are the synonyms of Cantharis?
What is the symbolic formula of Potassium Bitartrate?
What is the object of having an official Latin title, and what use is made of it?
Why is the Latin language selected for this title?
Under what circumstances is it allowable to abbreviate official Latin titles?
When are abbreviations improper?
What does the official definition indicate?
In choosing the official name, what part of the botanical name of a plant is preferred?
What exceptions are there to this rule?
When several parts of the same plant are used, how are they distinguished?
When two or more plants of the same genus are official, how are they distinguished?
Are the Latin names of drugs usually in the singular or the plural number?
What reason is assigned for this?
In the case of compound medicines, how have the names been selected?
Where medicines have too many important ingredients to admit of selection, how have they been named?
What is meant by the official English title of a Pharmacopœial substance?
Under what circumstances should the official English title be used?

The common or popular names having been discarded and other names substituted, what, for example, are the present names of the drugs formerly known as Blood-root, Calabar Bean, Male Fern, Yellow Jasmine?
Why has this change been made?
Have all the common names been changed? If not, give an example and the reason why it was not changed.
What important change in the English names of chemical substances was made in the U. S. Pharmacopœia of 1890? Why was this done?
How are the higher and lower forms of the salts of iron and mercury differentiated? Give an example.
How are the compounds of mercury further distinguished?
Why is the term "iron" retained for the scale salts of iron?
Do the pharmacopœial names of chemical substances always represent their chemical composition? If not, give an example of one that does not, and the reason for not using the systematic name.
Were the proprietary or trade names for synthetic remedies introduced into the U. S. P. IX?
Give an illustration of the rule followed.
Why are abbreviations used in the U. S. P. IX?
What is meant by a synonym?
Is it desirable to increase the use of synonyms?
Why are they used?
Where are synonyms placed in the present Pharmacopœia? Why?
Does the use of a synonym for an official article alter the standard required?
What is meant by the botanical name of a plant?
How is it usually derived?
Why is it important to know the botanical names of plants?
What is the meaning of the official abbreviation "Fam." used after the botanical name? What does this replace in former Pharmacopœias?
What are symbolic formulas?
What are the objects of their employment?
What do the figures following a symbolic formula indicate?
What is meant by molecular weight?
What is an atom?
Describe what is meant by the official definition of a drug or chemical.
What was the purpose in introducing the "purity rubric"?
How will it prevent unjust prosecutions?
What is meant by the official description of a drug?
What are the objects of having official descriptions?
What is an assay process? How are alkaloidal drugs usually assayed?
What is meant by "gravimetric" assay?
By "volumetric" assay?
Why was an average dose introduced into the U. S. P.? What was the need for doses in the Pharmacopœia?
Describe the principle of "solids by weight and liquids by measure" adopted by the U. S. Pharmacopœia.
What is the standing and object of the National Formulary?
What is a Dispensatory?
Name the two principal Dispensatories published in the United States.

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PART I

CHAPTER I

METROLOGY

Weight, Measure, and Specific Gravity

METROLOGY formerly and according to its strictest signification meant the science of measures, but its present definition includes the measure of the gravitating force of bodies, which always bears a direct ratio to their mass, and is commonly called *weight;* the determination of the bulk or extent of the body, its *measure;* and the relation which measure bears to weight when compared with a standard is known as *specific gravity.*

Weight

A knowledge of the systems of weights and measures in use must necessarily command the early attention of the student, and a short account of the origin of the present systems may be of service in fixing upon the mind the essential distinctions between them. The sense of the weight of a body cannot be conveyed intelligibly to the mind unless a means of comparison is chosen, and as weight is the measure of the gravitating force of a body, so this force is expressed as related to a standard of resistance, this being exactly that which would balance the body and keep it in equilibrium. Such standards are termed *weights.*

The standards which have been chosen by various nations are arbitrary, and instances are common where different standards are in use at the same time in the same country. Many of the ancient standards are clearly referable to parts of the human body, as nail, foot, span, pace, cubit (length of the forearm), orgyia (stretch of the arms). In the history of metrology three periods may be traced: 1. The *Ancient,* during which the old classical standards originated, and which terminated with the decline of the Roman Empire. 2. The *Mediæval,* extending to the sixteenth century. In this period the old standards were lost, but their names were preserved, and European nations adopted various independent standards. 3. The *Modern.* Since the seventeenth century the efforts of most enlightened nations have been directed toward greater accuracy and simplicity, and during the present century toward international uniformity.

In Great Britain, in the year 1266, the 51st act of the reign of Henry III. declares "that by the consent of the whole realm of England the measure of the King was made,—that is to say, that an English silver penny called the sterling, round and without clipping, shall weigh *thirty-two grains of wheat,* well dried and gathered out of

the middle of the ear ; and twenty pence (pennyweights) do make an ounce, and twelve ounces a pound, and eight pounds do make a gallon of wine, and eight wine gallons do make a bushel, which is the eighth of a quarter."

The sixteen-ounce pound (avoirdupois) was derived from a more ancient source, and was undoubtedly of Roman origin, and introduced at the time of the first civilization of the British island. The word "haberdepois," according to Gray, was, however, first used in English laws in 1303.

A statute of Edward I. (A.D. 1304) states "that every *pound* of money or of *medicines* is of *twenty shillings weight*, but the pound of all other things is *twenty-five shillings weight*. The *ounce* of *medicines* consists of *twenty pence*, and the *pound* contains *twelve* ounces (the Tower Pound), but in other things the pound contains *fifteen* ounces, in both cases the ounce weighing twenty pence."

These laws unfold the theory of the ancient weights and measures of Great Britain, and reveal the standard,—*i.e.*, a natural object, grains of wheat ; a difference existed then between the troy and the avoirdupois pound, but the weights now in use are one-sixteenth heavier than those of Edward I., owing to the change made in the value of the coin by the sovereign subsequently ; in addition to this, the true pennyweight standard was lost, and on the next revision of the weights and measures the present troy and avoirdupois standards were adopted. The old Tower or troy ounce and the avoirdupois ounce were intended to have the same weight, but after the revision it was found that the troy ounce was heavier than the avoirdupois ounce by forty-two and a half grains.

The subsequent adoption of troy weight by the London College of Physicians in 1618, on the recommendation of Sir Theodore Turquet de la Mayerne, who compiled their first Pharmacopœia, has entailed upon all apothecaries who are governed by British customs, to this day, the very great inconvenience of buying and selling medicines by one system of weights and compounding them by another.

In the next century efforts were made toward reforming the standards, and the Royal Society, in 1736, began the work, which ended in the preparation, under the direction of the House of Commons, by Mr. Bird, of the standard "yard" and standard "pound" troy in 1760. Copies of these have been made, no intentional deviation has been made since, and they are still the standards used most largely in the United States. In 1816, on account of the growing popularity of the French metrical system, and in view of the desirability of securing a standard which could easily be recovered in case of loss or destruction and which should be commensurable with a simple unit, steps were taken in England to secure these advantages. The labors of English scientists led to the adoption of the *Imperial* measures and standards, which were legalized January 1, 1826, and are now in general use in Great Britain.

In this system the *yard* is equivalent to 36 inches, and its length was determined by comparison with a pendulum beating seconds of mean time, in a vacuum, at the temperature of 62° F. at the level of the sea, in the latitude of London, which length was found to be 39.1393 inches. The *pound troy* (containing 5760 grains) was determined by compari-

son with a given measure of distilled water under certain conditions. Thus, a cubic inch of distilled water was weighed with brass weights in air at 62° F., the barometer at 30 inches, and it weighed 252.458 grains. The standard for measures of capacity (either dry or liquid) is the *gallon*, and this contains 10 pounds avoirdupois (each 7000 grains) of distilled water weighed in air at 62° F., the barometer standing at 30 inches, the *bushel* containing 8 such gallons. In 1819-20 efforts were made in the United States to secure uniformity in the standards which were in use by the several States. Finally, after a lengthy investigation, the Secretary of the Treasury, on June 14, 1836, was directed by Congress to furnish each State in the Union with a complete set of the revised standards, and thus we have the *troy pound* (5760 grains), the *avoirdupois pound* (7000 grains), and the *yard* (36 inches) all identical with the British standards; but the *gallon* is quite different, the old wine gallon of 231 cubic inches, containing 58372.2 grains of distilled water at its maximum density, weighed in air of the temperature of 62° F., the barometer standing at 30 inches, *being retained*, while the bushel contains 77.6274 pounds of water under the same conditions.[1]

In 1864 the use of the metric measures was legalized in Great Britain, but not made compulsory, and in 1866 the United States followed the same course.

By the United States law of July 28, 1866, all lengths, areas, and cubic measures are derived from the international meter equivalent to 39.37 inches. Since 1893 the United States Office of Standard Weights and Measures has been authorized to derive the yard from the meter, 1 yard equals $\frac{3600}{3937}$ meter, and the customary weights are referred to the kilogramme by Executive order approved April 5, 1893. All capacities are based on the equivalent 1 cubic decimeter equals 1 liter, the decimeter being equal to 3.937 inches. The gallon still remains at 231 cubic inches and the bushel contains 2150.42 cubic inches. The customary weights are derived from the international kilogramme based on the value that 1 avoirdupois pound = 453.5924277 grammes and that $\frac{5760}{7000}$ avoirdupois pound equals 1 troy pound.

Apothecaries Weight (also called Troy Weight)

Pound		Troy Ounces		Drachms		Scruples		Grains
1	=	12	=	96	=	288	=	5760
		℥ 1	=	8	=	24	=	480
				ʒ 1	=	3	=	60
						℈ 1	=	gr. 20

The British Pharmacopœia of 1898, while giving alternative equivalents in the metric system, adopted avoirdupois weight (termed Imperial weight) for expressing quantities which were to be weighed. Avoirdupois weight is also in general use in the United States for commercial purposes. The British Pharmacopœia of 1914 has, however, adopted the metric system exclusively for its processes and tests.

Avoirdupois Weight

Pound		Ounces		Grains
lb 1	=	16	=	7000
		oz. 1	=	437.5

[1] Slight variations in these original equivalents are recommended by various investigators, and have been in use since Hassler made his report in 1832.

It will be observed that the troy ounce contains 42½ grains *more* than the avoirdupois ounce, while the troy pound contains 1240 grains *less* than the avoirdupois pound. Fortunately, one unit common to troy, or apothecaries, and avoirdupois weight has been saved,—namely, *the grain*. The abbreviations of the denominations of apothecaries weight are represented by the signs ℥, ounce, ʒ, drachm, ℈, scruple, and gr. grain; these have long been in use, but are very likely to be mistaken for one another in rapid or careless writing. The abbreviations or signs for avoirdupois weight differ from those of troy weight, and care should be used not to confound them; they are lb., pound, oz., ounce, gr., grain.

Measures

Apothecaries or Wine Measure, U. S.

Gallon		Pints		Fluidounces		Fluidrachms		Minims
Cong. 1	=	8	=	128	=	1024	=	61440
		O.1	=	16	=	128	=	7680
				f ℥ 1	=	8	=	480
						f ʒ 1	=	♏ 60

Imperial Measure, Br.

(Used in Great Britain)

Gallon		Pints		Fluidounces		Fluidrachms		Minims
C. 1	=	8	=	160	=	1280	=	76800
		O.1	=	20	=	160	=	9600
				fl. oz. 1	=	8	=	480
						fl. dr. 1	=	min. 60

When the subject of the weights and measures in ordinary use is studied, the want of simplicity and close relation is clearly apparent. The pint of distilled water at 15.6° C. (60° F.), weighs 7291.2 grains, the fluidounce 455.7 grains, and at 25° C. (77° F.) (the temperature adopted for taking specific gravities and solubilities by the U. S. P. IX), the pint weighs 7273.1 (7273.125) grains and the fluidounce 454.6 grains, or, more accurately, 454.5703 grains. We have thus three ounces in use of different values,—troy ounce, 480 grains; avoirdupois ounce, 437.5 grains; and fluidounce, 454.6 grains.

The U. S. gallon of water weighs 8.33 avoirdupois pounds, and the pint weighs 1.0416 avoirdupois pounds; the pound equals 0.9601 pints.

The Imperial measure differs from our wine measure principally in having twenty fluidounces in the pint instead of sixteen. A convenient relation exists, however, between measure and weight in the *Imperial gallon, which contains ten avoirdupois pounds of water* at 15.6° C. (60° F.).

The Imperial fluidounce contains the same number of grains as the avoirdupois ounce (437.5), which is 18.2 grains less than that of the U. S. fluidounce of water at the same temperature (455.7). Although this difference may be considered trifling in one fluidounce, it is not so when multiplied by four or eight, and this is one serious objection to the use of the English graduated measures in the United States, because they indicate Imperial fluidounces instead of U. S. fluidounces.

Approximate Measures

In apportioning doses for a patient, the practitioner is usually compelled to order the liquid medicine to be administered in certain quantities that have been established by custom, and estimated as follows:

	Old form	Metric
A tumblerful	f ℥ viii	240 mils
A teacupful	f ℥ iv	120 mils
A wineglassful	f ℥ ii	60 mils
A tablespoonful	f ℥ iv	15 mils
A dessertspoonful	f ℥ ii	8 mils
A teaspoonful	f ℥ i	4 mils

A drop, through a popular error, is considered to be 1 minim.[1]

The equivalents given above for the teaspoonful, dessertspoonful, and tablespoonful are authorized by the U. S. P. IX.

In almost all cases the modern teacups, tablespoons, dessertspoons, and teaspoons, after careful tests by the author, were found to average 25 per cent. greater capacity than the theoretical quantities given above, and the use of accurately graduated medicine glasses, which may be had now at a trifling cost, should be insisted upon (see Fig. 1).

Fig. 1

Graduated medicine glass

The Metric System.—This system, which originated with Prince de Talleyrand, Bishop of Autun, France, in 1790, seems destined to become universal, as it is now legally used by the majority of all civilized nations, and finds especial favor with scientists even in countries where its use is not compulsory. The starting-point was the *unit* of *length*, the **meter**, which is the $\frac{1}{40,000,000}$ part of the earth's circumference around the poles. From this, the *unit of capacity* was derived, the **liter**, which is the cube of $\frac{1}{10}$ part of a meter. The *unit of weight*, the **gramme**, was also derived from the meter, it being the weight of that quantity of distilled water, at its maximum density, 4° C. (39.2° F.), which will fill the cube of $\frac{1}{100}$ part of a meter.[2] The name Metrical System, it will thus be seen, is very appropriate, as *each unit is derived from the meter;* it is also known as the *Decimal System*, because in obtaining the multiples and subdivisions the number ten (*decem*) is used solely. The prefixes, which indicate *multiplication*, are of Greek derivation and are usually spelled with a capital letter,—**Deka**, 10; **Hecto**, 100; **Kilo**, 1000; **Myria**, 10,000; while *division* of the units is expressed by Latin prefixes, the initial letters not being capitals,—**deci**, $\frac{1}{10}$; **centi**, $\frac{1}{100}$; **milli**, $\frac{1}{1000}$. The word Gild has been suggested as a useful mnemonic, thus:

G	I	L	D
reek	ncreases,	atin	ecreases

[1] See comparative table, page 77.

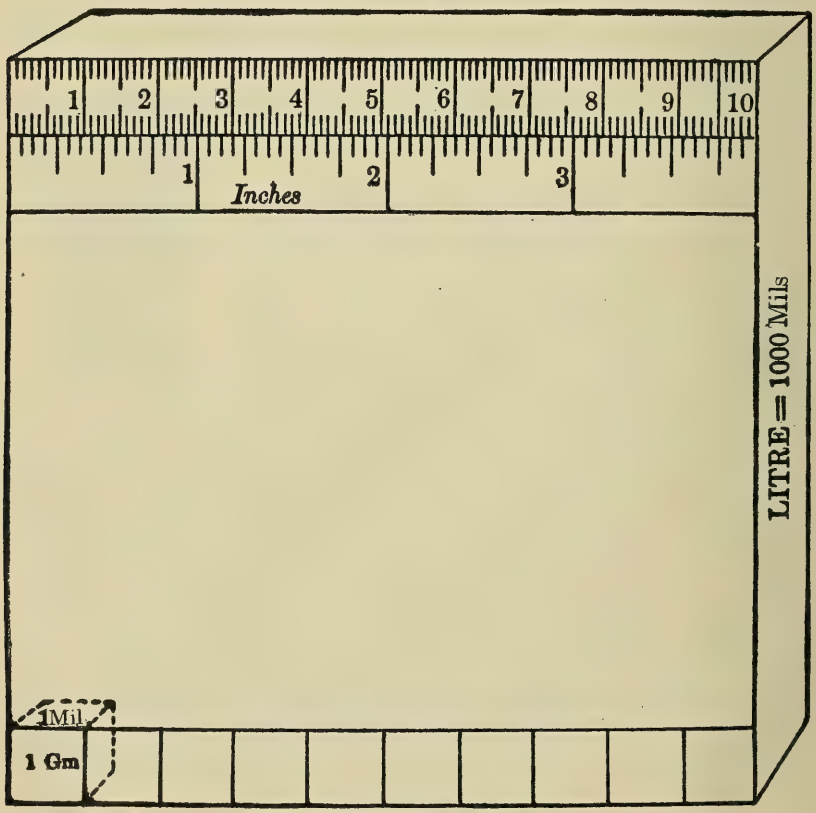
[2] The unit of surface measure, the *are*, being the square of ten meters, and the unit of solid measure, the *stere*, having the capacity of a cubic meter need not claim the attention of the practical pharmacist.

The following table gives a view of the system adapted to the use of the student:

	Abbreviation	Meter		Abbreviation	Liter		Abbreviation	Gramme
1 milli	meter, mm. =	.001	1 milli	liter, ml. or mil =	.001	1 milli	gramme, mg. =	.001
1 centi	meter, cm. =	.01	1 centi	liter, cl. =	.01	1 centi	gramme, cg. =	.01
1 deci	meter, dm. =	.1	1 deci	liter, dl. =	.1	1 deci	gramme, dg. =	.1
	Meter, M.	**1.**		**Liter, L.**	**1.**		**Gramme, Gm.**	**1.**
1 Deka	meter, Dm. =	10.	1 Deka	liter, Dl. =	10.	1 Deka	gramme, Dg. =	10.
1 Hecto	meter, Hm. =	100.	1 Hecto	liter, Hl. =	100.	1 Hecto	gramme, Hg. =	100.
1 Kilo	meter, Km. =	1000.	1 Kilo	liter, Kl. =	1000.	1 Kilo	gramme, Kg. =	1000.
1 Myria	meter, Mm. =	10000.	1 Myria	liter, Ml. =	10000.	1 Myria	gramme, Mg =	10000.

In pharmaceutical practice a number of the above measures are rarely or never used. Of the measures of length, the *millimeter* (mm.) and *centimeter* (cm.) are employed in the U. S. Pharmacopœia in the descriptions of drugs. In microscopy *micromillimeter* (mkm.), or pref-

FIG. 2



Metric diagram

erably, micron (μ), signifies the thousandth part of a millimeter, and is often used, but the Pharmacopœia has adopted the decimal part of a millimeter instead of the micron, under powdered drugs, thus, under Cinchona the starch grains are described as being "from 0.003 to 0.015

mm. in diameter." In measures of capacity, the term *milliliter* was, for many years, generally replaced by the term *cubic centimeter* (Cc.) in chemical and pharmaceutical practice but the more accurate term *milliliter*, or its abbreviated form *mil* or *ml.*, has now been adopted by the United States Pharmacopœia, the National Formulary and the U. S. Bureau of Standards. For all practical purposes the two terms have the same value, 1 mil being equivalent to 1.000027 cubic centimeters. This difference amounts to only 1½ minims in a gallon and may be disregarded. The mil and the liter have been chosen as the most convenient units for measure. In weight, the *milligramme*, *centigramme*, *gramme*, and *kilogramme* are selected; the latter being the commercial unit for larger quantities of drugs, and called *kilo*. This habit of appropriating only certain of the most convenient denominations for practical work has an analogy in the disuse of the theoretical terms of the system of United States coinage. Thus, the double eagle, eagle, and dime are ignored, while dollars and cents are preferred as units. The principal merits of the metric system are: 1. That every weight and measure bears a simple relation to the initial unit, the meter. 2. That every unit is multiplied or divided by the same number (*i.e.*, 10) to obtain the various denominations, and increase or decrease is expressed by simply moving the decimal point. 3. Its almost universal adoption makes it an international system.

Length.—*Meter.* Each side of the square (Fig. 2) measures 1 decimeter, one is graduated into tenths (*centimeters*); and these into tenths (*millimeters*); (the scale beneath shows the comparison with inches): 10 decimeters = 1 METER = 39.3700 in. (remember three threes, 3 ft., 3 in., 3 eighths).

Capacity.—*Liter.* A hollow cube having each side of the same size as the square would hold a LITER = 1000 mils = 2.11342 pints.

Weight.—*Gramme.* The weight of distilled water at 4° C. (39.2° F.) contained in a cube of the $\frac{1}{1000}$ of a liter is equal to a GRAMME = 15.432 grains, and measures 1 *milliliter* (see Fig. 2).

The advantages of the metric system have become more and more apparent upon examination, and its simplicity, brevity, and adaptability to every-day needs are now universally conceded. The progress which it had made in this country up to 1890 fully warranted its exclusive adoption in the U. S. Pharmacopœia; hence definite quantities were given and metric weights and measures alone employed. The necessity for knowing thoroughly the denominations of all the systems in present use is one of the evils common to the age in which we live, and it must ever be a source of regret that when the young Republic, more than a century ago, abolished the complex system of coinage and adopted the decimal system, it did not go a step farther and adopt the same principle in weights and measures.

The chief disadvantage of the metric system is one which inheres to the decimal principle of arithmetic,—namely, that the number ten cannot be divided more than once without producing a fraction, as, 10, 5, 2.5, 1.25, 0.625. The practice of dividing five into the three parts of 2, 2, and 1 partly compensates for this defect, and metric weights are constructed on this principle. The use of the metric weights and measures in the text of the U. S. Pharmacopœia makes it necessary for every pharmacist to become familiar with them, and

therefore an easy method of remembering their relations to one another and their equivalents in other systems is desirable. The following equivalents are derived from those established by Congress for use in legal proceedings, or are based upon the trustworthy determinations of Captain Clarke and Prof. Miller, while the accompanying rules, which show the methods of using the equivalents, are preferred for scientific determinations, on account of giving more accurate results. When very fine calculations are unnecessary, it will be found that the tables of equivalents given on pages 50 to 58 will prove sufficiently accurate for most pharmaceutical work.

To convert metric weights or measures into those in ordinary use:

RULE.—**Multiply the metric quantities by the corresponding equivalent.**

Ex.—The equivalent of *one meter* is 39.370+ inches, and five meters would be 196.85 inches: $39.370 \times 5 = 196.85$. To convert

Meters	into *inches,*	multiply by	39.370
Centimeters	" *inches,*	"	0.3937
Millimeters	" *inches,*	"	0.03937

As *one liter,* or 1000 mils, is equal to 33.8147+ fluidounces, or 35.196 Imperial fluidounces, to convert

Liters	into *fluidounces,*	multiply by	33.815
Mils	" *fluidounces,*	"	0.0338
Liters	" *pints,*	"	2.113
Liters	" *Imperial pints,*	"	1.7598
Liters	" *Imperial gallons,*	"	0.2199
Mils	" *Imperial fluidounces,*	"	0.0352

As *one gramme* is equal to 15.432+ grains, or 0.03527 avoirdupois ounce, or 0.03215 troy ounce, to convert

Grammes	into *grains,*	multiply by	15.432
Centigrammes	" *grains,*	"	0.15432
Milligrammes	" *grains,*	"	0.01543
Kilogrammes	" *avoirdupois ounces,*	"	35.2739
Grammes	" *avoirdupois ounces,*	"	0.03527
Kilogrammes	" *avoirdupois pounds,*	"	2.2046
Kilogrammes	" *troy ounces,*	"	32.1507
Grammes	" *troy ounces,*	"	0.03215

To convert the weights and measures in ordinary use into metric weights and measures:

RULE.—**Multiply the quantities by the corresponding metric equivalent.**

As *one inch* is equal to 0.0254 meter, *one fluidounce* to 29.5729 mils, *one Imperial fluidounce* to 28.4123 mils, *one* grain to 0.0648 gramme, *one avoirdupois ounce* to 28.3495 grammes, and *one troy ounce* to 31.1035 grammes, to convert

Inches	into	*meters,*	multiply by	0.0254
Inches	"	*centimeters,*	"	2.5400
Inches	"	*millimeters,*	"	25.4000
Pints	"	*liters,*	"	0.4731
Fluidounces	"	*mils*	"	29.5729
Imperial pints	"	*liters,*	"	0.5682
Imperial gallons	"	*liters,*	"	4.5456
Imperial fluidounces	"	*mils,*	"	28.4123
Grains	"	*grammes,*	"	0.0648
Grains	"	*centigrammes,*	"	6.4799
Grains	"	*milligrammes,*	"	64.799
Avoirdupois ounces	"	*kilogrammes,*	"	0.02835
Avoirdupois ounces	"	*grammes,*	"	28.3495
Avoirdupois pounds	"	*kilogrammes,*	"	0.4536
Troy ounces	"	*kilogrammes,*	"	0.0311
Troy ounces	"	*grammes,*	"	31.1035

It will be observed that there is a slight difference in the smaller quantities, increasing in the larger, between the equivalents in the following tables and those above given. This is owing to the fact that the temperature used as a basis for the metric units is 4° C., instead of 15.6° C., and the equivalents in the old form weights and measures in the table must correspond. The column upon the left of the page gives the weight in grains from one hundred pounds down; the difference in value from the next column is due to the variation in temperature standards; the fluidounce equivalent at 15.6° C. (60° F.) is 455.7 grains; the fluidounce at 25° C. (77° F.) weighs 454.6 grains; the fluidounce at 4° C. (39.2° F.) in vacuo weighs 456.392 grains. For practical work in pharmacy the discrepancy is too trivial to give serious annoyance.

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TABLE OF METRIC AND OLD FORM EQUIVALENT WEIGHTS AND MEASURES

(100 lbs. av. to $\frac{1}{1000}$ of a grain)

Weights, Old Form.					Metric Weight and Measure.	Measures, Old Form.				
		Avoirdupois.				Fluid.				
Equivalent in grains. (Temp. 15.6° C., 60° F.)*	Grains.	lb.	oz.	grains.	Gm.] [Mils.	gal.	pts.	fluid oz.	minims.	Fluid-ounces and fractions.
698938.5	**700000**	**100**	...	.....	45359.2	11	7	13	369.1	1533.769
693403.1	694456.0	99	3	143.5	**45000**	11	7	1	298.6	1521.622
677994.3	679023.7	97	0	23.7	**44000**	11	4	15	388.0	1487.808
663991.8	**665000**	**95**	...	.....	43091.3	11	3	1	38.9	1457.081
647176.5	648159.0	92	9	221.5	**42000**	11	0	12	86.9	1420.181
641625.6	642599.6	91	12	349.6	41639.8	**11**	...	...	.....	**1408**
629044.6	**630000**	**90**	...	.....	40823.3	10	6	4	188.2	1380.392
616358.4	617294.3	88	2	419.3	**40000**	10	4	8	265.4	1352.553
594097.5	**595000**	**85**	...	.....	38555.4	10	1	7	337.4	1303.703
585540.3	586429.5	83	12	179.5	**38000**	10	0	4	444.0	1284.925
583296.0	584181.4	83	7	118.9	37854.3	**10**	...	...	.....	**1280**
559150.7	**560000**	**80**	...	.....	36287.4	9	4	11	7.2	1227.015
554722.7	555564.8	79	5	377.3	**36000**	9	4	1	142.8	1217.298
524966.4	525763.3	75	1	325.8	34068.9	**9**	...	...	.....	**1152**
524203.6	**525000**	**75**	...	.....	34019.4	8	7	14	156.5	1150.326
523904.2	524700.1	74	15	137.6	**34000**	8	7	13	320.1	1149.669
493086.5	492835.4	70	8	335.3	**32000**	8	3	10	20.2	1082.042
489256.8	**490000**	**70**	...	.....	31751.5	8	3	1	306.2	1073.638
466636.8	467345.2	66	12	95.2	30283.5	**8**	...	...	.....	**1024**
462268.9	462970.7	66	2	95.7	**30000**	7	7	6	199.2	1014.415
454309.7	**455000**	**65**	...	.....	29483.5	7	6	4	455.5	996.949
431450.8	432106.0	61	11	293.4	**28000**	7	3	2	377.8	946.787
419362.9	**420000**	**60**	...	.....	27215.5	7	1	8	.....	920.261
408307.2	408927.0	58	6	302.0	26498.0	**7**	...	...	.....	**896**
400632.8	401241.3	57	5	53.8	**26000**	6	6	15	76.3	879.159
385224.2	385808.9	55	1	371.4	**25000**	6	4	13	166.1	845.346
384416.2	**385000**	**55**	...	.....	24947.6	6	4	11	275.0	843.573
369815.1	370376.6	52	14	251.6	**24000**	6	2	11	255.4	811.532
349977.6	350509.0	50	1	71.4	22712.6	**6**	...	...	.....	**768**
349469.1	**350000**	**50**	...	.....	22679.6	5	7	14	424.3	766.884
338997.1	339511.8	48	8	11.8	**22000**	5	6	7	434.0	743.904
314522.3	**315000**	**45**	...	.....	20411.7	5	3	2	94.1	690.196
308179.0	308647.1	44	1	209.6	**20000**	5	2	4	132.5	676.276
291648.0	292090.7	41	11	178.2	18927.2	**5**	...	...	.....	**640**
279575.1	**280000**	**40**	...	.....	18143.7	4	6	5	243.4	613.507
277360.9	277782.4	39	10	407.4	**18000**	4	6	0	311.0	608.648
246543.3	246917.7	35	4	167.7	**16000**	4	1	13	10.1	541.021
244628.4	**245000**	**35**	...	.....	15875.7	4	1	8	393.1	536.819
233318.4	233672.6	33	6	47.6	15141.7	**4**	...	...	.....	**512**
231134.2	231485.3	33	1	47.8	**15000**	3	7	11	99.4	507.207

* For explanation, see page 49.

Weights, Old Form.					Metric Weight and Measure.	Measures, Old Form.				
		Avoirdupois.				Fluid.				
Equivalent in grains. (Temp. 15.6° C., 60° F.)	Grains.	lb.	oz.	grains.	Gm.] [Mils.	gal.	pts.	fluid oz.	minims.	Fluid-ounces and fractions.
215725.2	216053.0	30	13	365.5	**14000**	3	5	9	188.6	473.393
209763.3	**210000**	**30**	...	.....	13607.8	3	4	12	62.9	460.131
184907.1	185188.3	26	7	125.8	**12000**	3	1	5	367.2	405.765
174988.8	175254.4	25	0	254.4	11356.3	**3**	...	...	.....	**384**
174734.5	**175000**	**25**	...	.....	11339.8	2	7	15	212.2	383.442
154089.5	154323.6	22	0	323.6	**10000**	2	5	2	66.2	338.138
139787.3	**140000**	**20**	...	.....	9071.8	2	3	2	361.4	306.753
138680.4	138821.2	19	13	203.7	**9000**	2	3	0	155.5	304.324
123718.6	123458.9	17	10	83.9	**8000**	2	0	14	245.2	270.511
116659.2	116836.3	16	11	23.8	7570.9	**2**	...	...	.....	**256**
107862.8	108026.5	15	6	401.5	**7000**	1	6	12	334.6	236.697
104840.6	**105000**	**15**	...	.....	6803.9	1	6	6	31.2	230.065
97851.4	**98000**	**14**	...	.....	6350.3	1	5	6	349.2	214.728
92453.7	92594.1	13	3	281.6	**6000**	1	5	4	423.8	202.883
90862.0	**91000**	**13**	...	.....	5896.7	1	4	7	187.2	199.390
83872.6	**84000**	**12**	...	.....	5443.1	1	3	8	25.1	184.052
77044.8	77161.8	11	0	161.8	**5000**	1	2	9	33.1	169.069
76883.2	**77000**	**11**	...	.....	4989.5	1	2	8	343.2	168.715
69893.9	**70000**	**10**	...	.....	4535.9	1	1	9	180.9	153.377
69340.3	69445.6	9	14	320.6	**4500**	1	1	8	77.8	152.162
62904.4	**63000**	**9**	...	.....	4082.3	1	...	10	18.8	138.039
61635.8	61729.4	8	13	41.9	**4000**	1	...	7	122.5	135.255
58329.6	58418.1	8	5	230.6	3785.4	**1**	...	...	.....	**128**
55915,1	**56000**	**8**	...	.....	3628.7	...	...	122	336.7	122.701
53931.3	54013.2	7	11	200.7	**3500**	...	...	118	167.2	118.348
48925.7	**49000**	**7**	...	.....	3175.1	...	...	107	174.6	107.364
46226.9	46297.1	6	9	359.6	**3000**	...	...	101	211.9	101.441
45570.0	45639.2	6	8	139.2	2957.4	...	...	**100**	.....	**100**
43747.2	43813.6	6	4	63.6	2839.1	...	...	**96**	.....	**96**
41936.3	**42000**	**6**	...	.....	2721.6	...	...	92	125.3	92.026
41013.0	41075.3	5	13	387.8	2661.6	...	...	**90**	.....	**90**
38522.6	38580.9	5	8	80.9	**2500**	...	...	84	256.8	84.535
36456.0	36511.4	5	3	198.9	2365.9	...	...	**80**	.....	**80**
34946.9	**35000**	**5**	...	.....	2268.0	...	...	76	330.2	76.688
31899.0	31947.4	4	9	9.9	2070.2	...	...	**70**	.....	**70**
30817.9	30864.7	4	6	239.7	**2000**	...	...	67	301.2	67.628
29276.9	29321.5	4	3	9.0	**1900**	...	...	64	118.1	64.246
29164.8	29209.1	4	2	334.1	1892.7	...	...	**64**	.....	**64**
27957.5	**28000**	**4**	...	.....	1814.4	...	...	61	168.4	61.351
27736.1	27778.2	3	15	215.7	**1800**	...	...	60	415.1	60.865
27342.0	27383.5	3	14	258.5	1774.4	...	...	**60**	.....	**60**
26195.2	26235.0	3	11	422.5	**1700**	...	...	57	232.1	57.484
24654.3	24691.8	3	8	191.8	**1600**	...	...	54	49.0	54.102
23113.4	23148.5	3	4	398.5	**1500**	...	...	50	346.0	50.721
22785.0	22819.6	3	4	69.6	1478.685	...	...	**50**	.....	**50**
22329.3	22363.2	3	3	50.7	1449.111	...	...	**49**	.....	**49**
21873.6	21906.8	3	2	31.8	1419.538	...	...	**48**	.....	**48**
21572.5	21605.3	3	1	167.8	**1400**	...	...	47	162.8	47.339
21417.9	21450.4	3	1	12.9	1389.964	...	...	**47**	.....	**47**
20968.1	**21000**	**3**	...	.....	1360.778	...	...	46	6.3	46.013
20962.2	20994.0	2	15	431.5	1360.390	...	...	**46**	.....	**46**
20506.5	20537.6	2	14	412.6	1330.817	...	...	**45**	.....	**45**

Weights, Old Form.					Metric Weight and Measure.	Measures, Old Form.			
		Avoirdupois.				Fluid.			
Equivalent in grains. (Temp. 15.6° C., 60° F.)	Grains.	lb.	oz.	grains.	Gm.] [Mils.	gal.	pts.	fluid oz.	minims.	Fluid-ounces and fractions.
20050.8	20081.2	2	13	393.7	1301.243	...	...	44	.....	44
20031.7	20062.1	2	13	374.6	1300	...	...	43	459.8	43.958
19595.1	19624.9	2	12	374.9	1271.669	...	...	43	.....	43
19193.4	19168.5	2	11	356.0	1242.095	...	...	42	.....	42
18683.7	18712.1	2	10	337.1	1212.522	...	...	41	.....	41
18490.8	18518.8	2	10	143.8	1200	...	...	40	276.8	40.577
18228.0	18255.7	2	9	318.2	1182.948	...	...	40	.....	40
17772.3	17799.3	2	8	299.3	1153.374	...	...	39	.....	39
17316.6	17342.9	2	7	280.4	1123.801	...	...	38	.....	38
16949.8	16975.6	2	6	350.6	1100	...	...	37	93.6	37.195
16860.9	16886.5	2	6	261.5	1094.227	...	...	37	.....	37
16405.2	16430.1	2	5	242.6	1064.653	...	...	36	.....	36
15949.5	15973.7	2	4	223.7	1035.080	...	...	35	.....	35
15493.8	15517.3	2	3	204.8	1005.506	...	...	34	.....	34
15409.0	15432.4	2	3	119.9	1000	...	...	33	390.6	33.814
15336.6	15060.9	2	2	185.9	975.932	...	...	33	.....	33
14638.5	14660.7	2	1	223.2	950	...	...	32	59.1	32.125
14582.4	14604.5	2	1	167.0	946.358	...	...	32	.....	32
14126.7	14148.2	2	...	148.2	916.875	...	...	31	.....	31
13979.1	14000	2	...	.....	907.185	...	...	30	324.2	30.676
13867.9	13889.1	1	15	326.6	900	...	...	30	207.6	30.432
13671.0	13691.8	1	15	129.3	887.211	...	...	30	.....	30
13542.0	13562.5	1	15	.....	878.635	...	...	29	344.1	29.717
13215.3	13235.0	1	14	10.4	857.637	...	...	29	.....	29
13105.5	13125	1	14	.....	850.486	...	...	28	363.9	28.759
13097.7	13117.5	1	13	430.0	850	...	...	28	356.0	28.742
12759.6	12779.0	1	13	91.5	828.064	...	...	28	.....	28
12668.5	12687.5	1	13	.....	822.136	...	...	27	383.8	27.800
12327.1	12345.9	1	12	95.9	800	...	...	27	24.5	27.051
12303.9	12322.6	1	12	72.6	798.490	...	...	27	.....	27
12231.4	12250	1	12	.....	793.787	...	...	26	403.7	26.841
11848.2	11866.2	1	11	53.7	768.916	...	...	26	.....	26
11794.9	11812.5	1	11	.....	765.437	...	...	25	423.6	25.883
11556.6	11574.3	1	10	199.0	750	...	...	25	173.0	25.360
11392.5	11409.8	1	10	34.8	739.343	...	...	25	.....	25
11357.9	11375	1	10	.....	737.087	...	...	24	443.4	24.924
10936.8	10953.4	1	9	15.9	709.769	...	...	24	.....	24
10921.3	10937.5	1	9	.....	708.738	...	...	23	463.3	23.966
10786.4	10802.6	1	8	302.6	700	...	...	23	321.4	23.670
10484.3	10500	1	8	.....	680.388	...	...	23	3.1	23.007
10481.1	10497.0	1	7	434.5	680.195	...	...	23	.....	23
10047.3	10062.5	1	7	.....	652.039	...	...	22	23.0	22.048
10025.4	10040.6	1	6	415.6	650.621	...	...	22	.....	22
10015.8	10031.0	1	6	406.0	650.	...	...	21	469.9	21.979
9610.7	9625	1	6	.....	623.689	...	...	21	42.9	21.09
9569.7	9584.2	1	5	396.7	621.048	...	...	21	.....	21
9245.2	9259.4	1	5	71.9	600	...	...	20	138.4	20.288
9173.7	9187.5	1	5	.....	595.340	...	...	20	62.7	20.131
9114.0	9127.8	1	4	377.8	591.474	...	...	20	.....	20
8736.7	8750	1	4	.....	566.990	...	...	19	82.6	19.172
8658.3	8671.4	1	3	358.9	561.900	...	...	19	.....	19
8475.1	8487.8	1	3	175.0	550	...	...	18	286.8	18.598

Weights, Old Form.					Metric Weight and Measure.	Measures, Old Form.			
Equivalent in grains. (Temp. 15.6° C., 60° F.)	Grains.	Avoirdupois.				Fluid.			Fluid-ounces and fractions.
		lb.	oz.	grains.	Gm.] [Mils.	gal. pts.	fluid oz.	minims.	
8300.1	8312.5	**1**	**8**	.....	538.641	... ...	18	102.5	18.214
8202.6	8215.1	1	2	340.1	532.327	... ...	**18**	.....	**18**
7863.1	**7875**	**1**	**2**	.....	510.291	... ...	17	122.4	17.255
7746.9	7758.7	1	1	321.2	502.753	... ...	**17**	.....	**17**
7704.5	7716.2	1	1	278.7	**500**	... ...	16	435.3	16.907
7426.5	7437.5	**1**	**1**	.....	481.942	... ...	16	142.2	16.297
7291.2	7302.3	1	...	302.3	473.179	... ...	**16**	.....	**16**
6989.5	**7000**	**1**	...	.....	453.592	... ...	15	162.1	15.338
6933.9	6944.6	...	15	382.1	**450**	... ...	15	103.8	15.216
6835.5	6845.9	...	15	283.4	443.606	... ...	**15**	.....	**15**
6552.5	6562.4	...	**15**	.....	425.243	... ...	14	182.0	14.379
6379.8	6389.5	...	14	264.5	414.032	... ...	**14**	.....	**14**
6163.8	6172.9	...	14	47.9	**400**	... ...	13	252.3	13.526
6115.9	**6125**	...	**14**	.....	396.893	... ...	13	201.8	13.421
5924.1	5933.1	...	13	245.6	384.458	... ...	**13**	.....	**13**
5678.9	5687.5	...	**13**	.....	368.544	... ...	12	221.7	12.462
5468.4	5476.7	...	12	226.7	354.884	... ...	**12**	.....	**12**
5393.2	5401.3	...	12	151.3	**350**	... ...	11	400.7	11.835
5241.9	**5250**	...	**12**	.....	340.194	... ...	11	273.1	11.570
5012.7	5020.3	...	11	207.8	325.311	... ...	**11**	.....	**11**
4805.4	4812.5	...	**11**	.....	311.845	... ...	10	261.4	10.545
4622.6	4629.7	...	10	254.7	**300**	... ...	10	69.2	10.144
4557.0	4563.9	...	10	188.9	295.737	... ...	**10**	.....	**10**
4368.3	**4375**	...	**10**	.....	283.495	... ...	9	281.3	9.586
4101.3	4107.5	...	9	170.0	266.163	... ...	**9**	.....	**9**
3931.8	3937.5	...	**9**	.....	255.146	... ...	8	301.2	8.628
3852.0	3858.1	...	8	358.1	**250**	... ...	8	217.7	8.453
3645.6	3651.1	...	8	151.1	236.590	... ...	**8**	.....	**8**
3494.8	**3500**	...	**8**	.....	226.796	... ...	7	321.0	7.669
3189.9	3194.7	...	7	132.2	207.016	... ...	**7**	.....	**7**
3081.9	3086.5	...	7	24.0	**200**	... ...	6	366.1	6.763
3057.7	3062.5	...	**7**	.....	198.447	... ...	6	340.9	6.710
2734.2	2738.4	...	6	113.4	177.442	... ...	**6**	.....	**6**
2621.2	**2625**	...	**6**	.....	170.097	... ...	5	360.8	5.752
2311.3	2314.9	...	5	127.4	**150**	... ...	5	34.6	5.072
2278.5	2282.0	...	5	94.5	147.869	... ...	**5**	.....	**5**
2184.2	**2187.5**	...	**5**	.....	141.748	... ...	4	380.7	4.793
1926.2	1929.0	...	4	179.0	**125**	... ...	4	108.8	4.227
1822.8	1825.6	...	4	75.6	118.295	... ...	**4**	.....	**4**
1747.2	**1750**	...	**4**	.....	113.398	... ...	3	400.5	3.834
1540.7	1543.2	...	3	230.7	**100**	... ...	3	183.1	3.381
1386.7	1388.9	...	**3**	76.4	**90**	... ...	3	20.8	3.043
1367.1	1369.2	...	3	46.7	88.721	... ...	**3**	.....	**3**
1310.6	1312.5	...	**3**	.....	85.049	... ...	2	420.4	2.876
1232.7	1234.6	...	2	359.6	**80**	... ...	2	338.5	2.705
1155.7	1157.4	...	2	282.4	**75**	... ...	2	257.3	2.536
1078.6	1080.3	...	**2**	205.3	**70**	... ...	2	176.1	2.367
924.6	925.9	...	2	50.9	**60**	... ...	2	13.8	2.029
911.4	912.8	...	2	37.8	59.147	... ...	**2**	.....	**2**
873.6	**875**	...	**2**	.....	56.699	... ...	1	440.3	1.917
770.6	771.6	...	1	334.1	**50**	... ...	1	331.5	1.691
616.6	617.3	...	1	179.8	**40**	... ...	1	169.2	1.353

From 1 troy ounce to ⅛ ounce av.

Weights, Old Form.			Metric Weight and Measure.	Measures, Old Form.	
Equivalent in grains. (Temp. 15.6° C., 60° F.)	Grains.	Drachms.	Gm.] [Mils.	Fluid-drachms.	Minims.
479.3	480	8=1℥	31.103	8.413	504.8
477.6	478.4	7.973	31	8.385	503.1
474.7	475.4	7.923	30.805	8½	500
469.3	470	7⅝ = 47/48℥	30.455	8.238	494.3
465.2	465.9	7.765	30.190	8¼	490
462.3	463.0	7.717	30	8.115	486.9
459.3	460	7⅞ = 23/24℥	29.807	8.063	483.8
455.7	456.392	7.607	29.573	8	480
449.3	450	7½ = 15/16℥	29.159	7.888	473.3
446.8	447.5	7.459	29	7.845	470.7
446.1	446.9	7.449	28.958	7⅝	470
439.3	440	7⅛ = 11/12℥	28.512	7.713	462.8
436.8	437.5	1℥ av.	28.350	7.668	460.1
436.7	437.4	7.290	28.341	7⅜	460
431.4	432.1	7.202	28	7.575	454.5
429.3	430	7⅛ = 43/48℥	27.864	7.537	452.2
427.2	427.9	7.132	27.725	7½	450
419.4	420	7 = ⅞℥	27.216	7.362	441.7
417.7	418.3	6.972	27.109	7⅓	440
416.1	416.7	6.945	27	7.303	438.2
409.4	410	6⅝ = 41/48℥	26.568	7.187	431.2
408.3	408.9	6.815	26.493	7⅛	430
400.6	401.2	6.687	26	7.033	422.0
399.4	400	6⅔ = ⅝℥	25.920	7.012	420.7
398.7	399.3	6.655	25.877	7	420
389.4	390	6½ = 13/16℥	25.271	6.837	410.2
389.2	389.8	6.497	25.261	6⅝	410
385.2	385.8	6.430	25	6.762	405.8
379.7	380.3	6.338	24.645	6⅔	400
379.4	380	6⅓ = 19/24℥	24.624	6.662	399.7
370.2	370.8	6.180	24.029	6½	390
369.8	370.4	6.173	24	6.492	389.5
369.4	370	6⅛ = 37/48℥	23.976	6.485	389.1
360.8	361.3	6.022	23.413	6⅓	380
359.5	360	6 = ¾℥	23.328	6.310	378.6
354.4	354.9	5.915	23	6.222	373.3
351.3	351.8	5.863	22.796	6⅛	370
349.5	350	5⅝ = 35/48℥	22.680	6.135	368.1
341.8	342.3	5.705	22.180	6	360
339.5	340	5⅔ = 17/24℥	22.032	5.960	357.6
339.0	339.5	5.658	22	5.952	357.1
332.3	332.8	5.547	21.563	5⅝	350
329.5	330	5½ = 11/16℥	21.384	5.785	347.1
323.6	324.1	5.401	21	5.680	340.8
322.8	323.3	5.388	20.948	5⅔	340
319.5	320	5⅓ = ⅔℥	20.736	5.610	336.6
313.3	313.8	5.230	20.332	5½	330
309.5	310	5⅛ = 31/48℥	20.088	5.433	326.0
308.1	308.6	5.143	20	5.410	324.6
303.8	304.3	5.072	19.716	5⅛	320

Weights, Old Form.			Metric Weight and Measure.		Measures, Old Form.	
Equivalent in grains. (Temp. 15.6° C., 60° F.)	Grains.	Drachms.	Gm.] [Mils.		Fluid-drachms.	Minims.
299.5	**300**	**5** = 5 ℈	19.440		5.258	315.5
294.3	294.7	4.912	19.099		**5**⅛	**310**
292.8	293.2	4.887	**19**		5.140	308.4
289.6	**290**	**4**⅝ = 29/48 ℈	18.792		5.083	305.0
284.8	285.2	4.753	18.483		**5**	**300**
279.6	**280**	**4**⅔ = 7/12 ℈	18.144		4.908	294.5
277.4	277.8	4.630	**18**		4.870	292.2
275.3	275.7	4.595	17.867		**4**⅝	**290**
269.6	**270**	**4**½ = 9/16 ℈	17.496		4.733	284.0
265.8	266.2	4.437	17.251		**4**⅜	**280**
262.0	262.4	4.373	**17**		4.598	275.9
259.6	**260**	**4**⅓ = 13/24 ℈	16.848		4.557	273.4
256.3	256.7	4.278	16.635		**4**½	**270**
249.6	**250**	**4**⅛ = 25/48 ℈	16.200		4.382	262.9
246.8	247.2	4.120	16.019		**4**⅓	**260**
246.5	246.9	4.115	**16**		4.328	259.7
239.6	**240**	**4** = ¼ ℈	15.552		4.207	252.4
237.3	237.7	3.962	15.403		**4**⅛	**250**
231.1	231.5	3.858	**15**		4.057	243.4
229.7	**230**	**3**⅝ = 23/48 ℈	14.904		4.032	241.9
227.9	228.2	3.803	14.787		**4**	**240**
219.7	**220**	**3**⅜ = 11/24 ℈	14.256		3.857	231.4
218.4	218.75	½ ℈ av.	14.175		3.835	230.1
218.36	218.69	3.645	14.171		**3**⅝	**230**
215.8	216.1	3.602	**14**		3.787	227.2
209.7	**210**	**3**½ = 21/48 ℈	13.608		3.682	220.9
208.9	209.2	3.487	13.555		**3**⅔	**220**
200.3	200.6	3.343	**13**		3.517	211.0
199.7	**200**	**3**⅓ = 5/12 ℈	12.960		3.505	210.3
199.4	199.7	3.328	12.938		**3**½	**210**
189.9	190.2	3.170	12.322		**3**⅓	**200**
189.7	**190**	**3**⅛ = 19/48 ℈	12.312		3.330	199.8
184.9	185.2	3.087	**12**		3.247	194.8
180.4	180.7	3.012	11.706		**3**⅛	**190**
179.7	**180**	**3** = ¾ ℈	11.664		3.155	189.3
170.8	171.1	2.852	11.090		**3**	**180**
169.7	**170**	**2**⅝ = 17/48 ℈	11.016		2.980	178.8
169.5	169.8	2.830	**11**		2.975	178.5
161.4	161.6	2.693	10.474		**2**⅝	**170**
159.8	**160**	**2**⅔ = ⅓ ℈	10.368		2.805	168.3
154.1	154.3	2.572	**10**		2.705	162.3
151.9	152.1	2.535	9.858		**2**⅔	**160**
149.8	**150**	**2**½ = 15/48 ℈	9.719		2.630	157.8
142.4	142.6	2.377	9.242		**2**½	**150**
139.8	**140**	**2**⅓ = 7/24 ℈	9.072		2.453	147.2
138.7	138.9	2.315	**9**		2.435	146.1
132.9	133.1	2.218	8.626		**2**⅓	**140**
129.8	**130**	**2**⅛ = 13/48 ℈	8.424		2.278	136.7
123.3	123.5	2.058	**8**		2.163	129.8
119.8	**120**	**2** = ¼ ℈	7.776		2.103	126.2
113.9	114.1	1.902	7.393		**2**	**120**
109.8	**110**	**1**⅝ = 11/48 ℈	7.128		1.928	115.7

Weights, Old Form.			Metric Weight and Measure.	Measures, Old Form.	
Equivalent in grains. (Temp. 15.6° C., 60° F.)	Grains.	Drachms.	Gm.] [Mils.	Fluid-drachms.	Minims.
109.2	109.375	$\frac{1}{4}\frac{z}{3}$ av.	7.087	1.917	115.0
107.8	108.0	1.800	7	1.893	113.6
99.8	100	$1\frac{2}{3} = \frac{5}{24}\frac{z}{3}$	6.480	1.753	105.2
94.9	95.1	1.585	6.161	$1\frac{2}{3}$	100
92.5	92.6	1.545	6	1.623	97.4
89.0	90	$1\frac{1}{2} = \frac{3}{16}\frac{z}{3}$	5.832	1.578	94.7
85.4	85.6	1.427	5.545	$1\frac{1}{2}$	90
79.9	80	$1\frac{1}{3} = \frac{1}{6}\frac{z}{3}$	5.184	1.401	84.1
77.1	77.2	1.287	5	1.351	81.2
76.0	76.1	1.268	4.929	$1\frac{1}{3}$	80
69.9	70	$1\frac{1}{8} = \frac{7}{48}\frac{z}{3}$	4.536	1.227	73.6
66.5	66.6	1.110	4.313	$1\frac{1}{8}$	70
61.6	61.7	1.028	4	1.082	64.9
59.9	60	$1 = \frac{1}{8}\frac{z}{3}$	3.888	1.051	63.1
56.9	57.0	.950	3.697	1	60
54.6	54.6875	$\frac{1}{8}\frac{z}{3}$ av.	3.544	.958	57.5

From 50 grains to 1 minim

Grains.	Metric Weight and Measure. Gm.] [Mils.	Minims.	Grains.	Metric Weight and Measure. Gm.] [Mils.	Minims.
50	3.240	52.6	36.1	2.341	38
49.0	3.175	51.5	36	2.333	37.9
48	3.110	50.5	35.2	2.280	37
47.5	3.081	50	35	2.268	36.8
47	3.046	49.4	34.2	2.218	36
46.6	3.019	49	34	2.203	35.8
46.3	3	48.7	33.3	2.156	35
46	2.981	48.4	33	2.138	34.7
45.6	2.957	48	32.3	2.095	34
45	2.916	47.3	32	2.074	33.7
44.7	2.896	47	31.4	2.033	33
44	2.851	46.3	31	2.009	32.6
43.7	2.834	46	30.9	2	32.5
43	2.786	45.2	30.4	1.972	32
42.8	2.773	45	30	1.944	31.6
42	2.722	44.2	29.5	1.910	31
41.8	2.711	44	29	1.879	30.5
41	2.657	43.1	28.5	1.848	30
40.9	2.649	43	28	1.814	29.4
40	2.592	42.1	27.6	1.787	29
39.9	2.588	42	27	1.750	28.4
39	2.527	41.0	26.6	1.725	28
38.98	2.526	41	26	1.685	27.3
38.03	2.464	40.0	25.7	1.664	27
38	2.462	39.97	25	1.620	26.3
37.1	2.403	39	24.7	1.602	26
37	2.398	38.9	24	1.555	25.2

Grains.	Metric Weight and Measure. Gm.] [Mils.	Minims.	Grains.	Metric Weight and Measure. Gm.] [Mils	Minims.
23.8	1.540	**25**	**12**	0.778	12.6
23.2	**1.5**	24.4	11.6	**0.75**	12.2
23	1.490	24.2	11.4	0.739	**12**
22.8	1.479	**24**	**11**	0.713	11.6
22	1.426	23.1	10.5	0.678	**11**
21.9	1.417	**23**	**10**	0.648	10.5
21	1.361	22.1	9.5	0.616	**10**
20.9	1.355	**22**	**9**	0.583	9.5
20	1.296	21.03	8.6	0.555	**9**
19.3	**1.25**	20.3	**8**	0.518	8.4
19.02	1.232	**20**	7.7	**0.5**	8.1
19	1.231	19.97	7.6	0.493	**8**
18.1	1.171	**19**	**7**	0.454	7.4
18	1.166	18.9	6.7	0.431	**7**
17.1	1.109	**18**	**6**	0.389	6.3
17	1.102	17.9	5.7	0.370	**6**
16.2	1.047	**17**	**5**	0.324	5.3
16	1.037	16.8	4.8	0.308	**5**
15.4324	**1**	16.2	**4**	0.259	4.2
15.2	0.986	**16**	3.8	0.246	**4**
15	0.972	15.8	**3**	0.194	3.2
14.3	0.924	**15**	2.9	0.185	**3**
14	0.907	14.7	**2**	0.130	2.1
13.3	0.863	**14**	1.9	0.123	**2**
13	0.842	13.7	**1**	0.065	1.0517
12.4	0.801	**13**	0.9508	0.06161	**1**

From $\frac{9}{10}$ grain to $\frac{1}{1000}$ grain.		Measures of length.				
Grammes.	Grains.	Centimetres.	Inches.	Millimetres.	Inches in decimal fractions.	Inches in common fractions.
0.058	$\frac{9}{10}$	**100**	39.37	25.4	**1**	**1**
0.057	$\frac{8}{9}$	99.0	**39**	**25**	0.98	
0.056	$\frac{7}{8}$	96.5	**38**	24.5	0.96	
0.055	$\frac{6}{7}$	**95**	37.40	**24**	0.94	
0.054	$\frac{5}{6}$	93.9	**37**	23.8	0.94	$\frac{15}{16}$
0.052	$\frac{4}{5}$	91.4	**36**	23.5	0.92	
0.049	$\frac{3}{4}$	**90**	35.43	**23**	0.90	$\frac{13}{32}$
0.045	$\frac{7}{10}$	88.9	**35**	22.5	0.89	
0.043	$\frac{2}{3}$	86.4	**34**	22.2	0.87	$\frac{7}{8}$
0.040	$\frac{5}{8}$	**85**	33.46	**22**	0.87	
0.039	$\frac{3}{5}$	83.8	**33**	21.5	0.85	
0.036	$\frac{9}{16}$	81.3	**32**	**21**	0.83	
0.032	$\frac{1}{2}$	**80**	31.50	20.6	0.81	$\frac{13}{16}$
0.028	$\frac{7}{16}$	78.7	**31**	20.5	0.81	
0.026	$\frac{2}{5}$	76.2	**30**	**20**	0.79	
0.022	$\frac{1}{3}$	**75**	29.53	19.5	0.77	
0.020	$\frac{5}{16}$	73.6	**29**	19.1	0.75	$\frac{3}{4}$
0.016	$\frac{1}{4}$	71.1	**28**	**19**	0.75	
0.013	$\frac{1}{8}$	**70**	27.56	18.5	0.73	

From $\frac{5}{10}$ grain to $\frac{1}{1000}$ grain.		Measures of length.				
Grammes.	Grains.	Centimetres.	Inches.	Millimetres.	Inches in decimal fractions.	Inches in common fractions.
0.012	$\frac{3}{16}$	68.6	27	18	0.71	
0.011	$\frac{1}{8}$	66.0	26	17.5	0.69	$\frac{11}{16}$
0.009	$\frac{1}{7}$	65	25.59	17	0.67	
0.008	$\frac{1}{8}$	63.5	25	16.5	0.65	
0.007	$\frac{1}{9}$	61.0	24	16	0.63	
0.0065	$\frac{1}{10}$	60	23.62	15.9	0.62	$\frac{5}{8}$
0.0054	$\frac{1}{12}$	58.4	23	15.5	0.61	
0.0042	$\frac{1}{16}$	55.9	22	15	0.59	
0.0040	$\frac{1}{16}$	55	21.65	14.5	0.57	
0.0036	$\frac{1}{18}$	53.3	21	14.3	0.56	$\frac{9}{16}$
0.0032	$\frac{1}{20}$	50.8	20	14	0.55	
0.0027	$\frac{1}{24}$	50	19.69	13.5	0.53	
0.0026	$\frac{1}{26}$	48.3	19	13	0.51	
0.0022	$\frac{1}{30}$	45.7	18	12.7	0.50	$\frac{1}{2}$
0.0020	$\frac{1}{32}$	45	17.72	12.5	0.49	
0.0018	$\frac{1}{36}$	43.2	17	12	0.47	
0.0016	$\frac{1}{40}$	40.6	16	11.5	0.45	
0.00135	$\frac{1}{48}$	40	15.75	11.1	0.44	$\frac{7}{16}$
0.00129	$\frac{1}{50}$	38.1	15	11	0.43	
0.00108	$\frac{1}{60}$	35.6	14	10.5	0.41	
0.00101	$\frac{1}{64}$	35	13.78	10	0.39	
0.00090	$\frac{1}{72}$	33.0	13	9.5	0.37	$\frac{3}{8}$
0.00081	$\frac{1}{80}$	30.5	12	9	0.35	
0.00065	$\frac{1}{100}$	30	11.81	8.7	0.34	$\frac{11}{32}$
0.00058	$\frac{1}{112}$	27.9	11	8.[illegible]	0.33	
0.00054	$\frac{1}{120}$	25.4	10	8	0.31	
0.00051	$\frac{1}{128}$	25	9.84	7.9	0.31	$\frac{5}{16}$
0.00045	$\frac{1}{144}$	22.9	9	7.5	0.30	
0.00043	$\frac{1}{150}$	20.3	8	7.1	0.28	$\frac{9}{32}$
0.00040	$\frac{1}{160}$	20	7.87	7	0.28	
0.00036	$\frac{1}{180}$	17.8	7	6.5	0.26	
0.00032	$\frac{1}{200}$	15.2	6	6.4	0.25	$\frac{1}{4}$
0.00027	$\frac{1}{240}$	15	5.91	6	0.24	
0.00025	$\frac{1}{256}$	12.7	5	5.6	0.22	$\frac{7}{32}$
0.00022	$\frac{1}{300}$	10.2	4	5.5	0.22	
0.00020	$\frac{1}{320}$	10	3.94	5	0.20	
0.00018	$\frac{1}{360}$	9	3.54	4.8	0.19	$\frac{3}{16}$
0.00016	$\frac{1}{400}$	8	3.15	4.5	0.18	
0.000135	$\frac{1}{480}$	7.6	3	4	0.16	
0.000129	$\frac{1}{500}$	7	2.76	3.5	0.14	
0.000127	$\frac{1}{512}$	6	2.36	3.2	0.13	$\frac{1}{8}$
0.000108	$\frac{1}{600}$	5.1	2	3	0.12	
0.000101	$\frac{1}{640}$	5	1.97	2.5	0.10	$\frac{1}{10}$
0.000093	$\frac{1}{700}$	4	1.57	2.4	0.09	$\frac{3}{32}$
0.000090	$\frac{1}{720}$	3	1.18	2	0.08	
0.000081	$\frac{1}{800}$	2.54	1	1.6	0.06	$\frac{1}{16}$
0.000077	$\frac{1}{840}$	2	0.78	1.5	0.06	
0.000072	$\frac{1}{900}$	1.5	0.59	1	0.04	
0.000068	$\frac{1}{960}$	1	0.39	0.8	0.03	$\frac{1}{32}$
0.000065	$\frac{1}{1000}$	0.75	0.30	0.5	0.02	
		0.50	0.20	0.1	0.0039	
		0.25	0.10			

Orthography, Pronunciation, and Reading

Orthography.—There are two methods of orthography of the metric units in use in the United States; in one of these, the original French, the units are spelled met*re*, lit*re*, gram*me;* in the other, proposed by the American Metric Bureau, the units are spelled met*er*, lit*er*, gram. It would not be appropriate in a treatise of this kind to discuss the merits of either plan, but it is unfortunate that in the U. S. Pharmacopœia of 1890 the question was not settled, the French gram*me* having been retained and met*er* and lit*er* adopted, and the same rule has been followed in the Ninth Revision of the Pharmacopœia. While the original orthography is used in the British Pharmacopœia, and is preferred by the author, the custom has now become established in the United States, and it is therefore followed in this work; some minor changes are desirable,—*i.e.*, *deca*, which is changed to *deka*, because *deca* could easily be mistaken for *deci*. In pharmacy particularly, *gramme* is to be preferred to *gram*, because in writing gram it could easily be mistaken for grain, particularly if the *i* in grain were not dotted.

Pronunciation.—Meter is pronounced mee'ter, liter lee'ter, gramme gram, not, as sometimes heard, gram'me; centimeter should be pronounced sen'tee-mee-ter, not son'tee-mee-ter. The latter faulty pronunciation is quite common, and is due to confounding the French pronunciation with the English. Either son-tee-mā'tr (French) or sen'tee-mee-ter (English) would be correct, but to use half of the French and half of the English is obviously improper, and, as the metric system is now anglicized, the simple English pronunciation is less stilted and more appropriate.

Reading.—Some difficulty is usually experienced by those unfamiliar with the metric system in reading the quantities. In the linear measures in Pharmacy, centimeters and millimeters are almost exclusively used; now, 0.05 M. would not be read five hundredths of a meter, but 5 centimeters (5 cm.); if the millimeter column contains a unit, as in 0.055 M., it is read fifty-five millimeters (55 mm.), in preference to fifty-five thousandths of a meter; or it is sometimes read five centimeters and five millimeters.

Fractions of a millimeter must be read decimally, as, 0.0555 mm., fifty-five and five-tenths millimeters. In measures of capacity, mils, millimeters or the old form cubic centimeters are exclusively used for quantities less than a liter, the terms half liter, quarter liter, deciliter, centiliter, milliliter are replaced by 500 mils, 250 mils, 100 mils, 10 mils, 1 mil; in aqueous liquids the mil is considered equivalent to a gramme. In weight, when the quantity is relatively large, and in commercial transactions, the kilogramme is abbreviated to kilo, pronounced kĭl'o; when less than a kilogramme, and not less than a gramme, the quantity is read with the gramme for the unit; 2000 Gm. would be read two kilos, and 543 Gm. would be read five hundred and forty-three grammes, while 2543 Gm. is usually read two kilos and five hundred and forty-three grammes, although twenty-five hundred and forty-three grammes is sometimes preferred. For quantities below the gramme, decigrammes are not used, but centigrammes and milli-

grammes are regarded as the most convenient units ; they are read in the same way as centimeters and millimeters.

Weighing and Measuring

Among the first operations that the student is called upon to perform are the very important ones of *weighing* and *measuring*. The former process requires the use of the *balance*, or, as more frequently, but less preferably, termed, *scales*. As the successful performance of many of the processes noticed in this work depends upon a thorough knowledge of the principles of the balance, it has been selected as one of the first subjects for consideration, for this instrument in some form or other is relied upon to secure accurate quantities of the substances employed in the various operations of pharmacy.

The balance may be defined as an instrument for determining the relative weights of substances, and should be *correctly constructed, skilfully used,* and *carefully protected from injury,* if accurate results are expected.

Construction of the Balance.—For systematic consideration pharmaceutical balances may be classified as follows : 1. *Single beam, equal arms.* 2. *Single beam, unequal arms.* 3. *Double beam, unequal arms.* 4. *Compound lever balances.* 5. *Torsion balances.*

1. Single Beam, Equal Arm Balances.—The instrument which, notwithstanding many attempts to supplant it, still maintains its supremacy is the *single beam, equal arm balance*, which may be described as consisting of a metallic lever or beam, divided into two equal arms at the centre by a knife edge, upon which it is supported. At exactly equal distances from this point of support, and situated in the same plane, are placed the end knife edges ; these suspend the pans which carry the substances to be weighed. A good balance should possess the following requirements :

1. *When the beam is in a horizontal position, the centre of gravity should be slightly below the point of support, or central knife edge, and perpendicular to it.*

The relative sensibility of the balance depends upon the fulfilment of this principle, which may be roughly illustrated by forcing a pin through the centre of an oblong piece of pasteboard ; if the edge of the pasteboard is touched slightly it does not oscillate at all, but revolves around the centre to a degree corresponding to the impulse representing equilibrium ; if the pin be removed and inserted a very short distance above the centre, and the edge of the pasteboard touched as before, it will oscillate slowly, corresponding to a sensitive beam, the point of support being slightly above the centre of gravity ; if the pin be again removed and inserted far above the centre, and the same impulse imparted to the edge, it will oscillate quickly, illustrating stable equilibrium and a beam which comes to rest quickly and is not sensitive. A more elaborate method of illustration is furnished by the use of a beam with a movable fulcrum (see Fig. 3), when the relative position of the knife edge may be made to show, beginning at the top, 1, stable equilibrium ; 2, in the centre, equilibrium ; and, 3, when the lowest point is reached, unstable equilibrium, and then the slightest impulse upsets the beam.

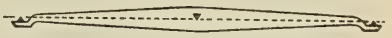
2. *The end knife edges must be at exactly equal distances from the central knife edge; they must all be in the same plane, and the edges absolutely parallel to each other.*

It is very apparent that the conditions of a good prescription balance cannot be satisfied if there is inequality in the length of the arms of

FIG. 3

Illustration of equilibrium

FIG. 4



Position of knife edges

the beam. In Fig. 4 the distance from the central knife edge to the one on the left must be exactly the same as the distance from the central knife edge to the one on the right, otherwise unequal weights would be required to establish equilibrium, or the excess of weight of the longer arm must be subtracted at every weighing, or weighing by substitution resorted to, all manifestly impracticable. If the central knife edge be placed either above or below a line drawn so that it connects the end knife edges, the loading of the pans will either cause the beam to cease oscillating, or diminish the sensibility in proportion to the load. If the knife edges are not parallel, the weight of a body would not be constant upon every part of the pan, but would be greater if placed near the edge on one side, and correspondingly less at a point directly opposite.

3. *The beam should be inflexible, but as light in weight as possible, and the knife edges in fine balances should bear upon agate planes.*

Rigidity of the beam is necessary, because any serious deflection caused by a loading of the pans would lower the end knife edges, and thus accuracy in weighing would be impossible. The beam should not be heavier than necessary, because its sensibility (particularly when light weights were placed upon the pans) would be thereby lessened, and to diminish friction arising from the rusting of the steel knife edges which constantly increases with the age and use of a balance, the bearings of the knife edges should be agate planes. Formerly this condition could not be practically carried out, except in expensive balances, owing to the cost of polished agate; but since the introduction of automatic machines for grinding and polishing this very hard substance, the cost has been so reduced that not only the bearings, but the knife edges themselves, are now made of agate and used upon fine prescription balances, and it is practical economy to employ exclusively those so mounted.

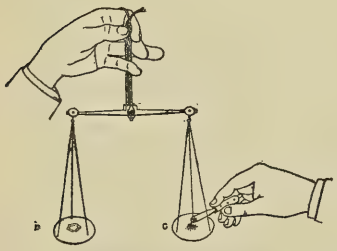
The Tests of a Balance.—Having stated the essential points in the construction of the balance, the tests, which should always be applied before accepting a balance, will now be described. The prescription balance, being one of the most delicate and important of the instruments in use by the pharmacist, is selected for illustration. 1. A perfectly level counter or table is secured, the balance is placed in position, the beam elevated so that it is free to oscillate, and when the oscillations have ceased, the smallest weight to which the balance is sensitive is placed upon the right hand pan,—it should at once respond to the weight; this tests its sensibility with unloaded pans. 2. Both

pans are now loaded with the full weight that the balance is designed to carry, and then the smallest weight is placed upon the right hand pan,—the oscillation, although slower than in the first test, ought to be as decided; this shows its sensibility when loaded. 3. The pans should now be loaded to half the capacity of the balance, and equilibrium perfected by adding, if necessary, a piece of tin foil. The weights on the right hand pan must now be exchanged for those on the left hand pan, and *vice versa;* if equilibrium is still maintained, *the arms of the beam are equal.* 4. The pans should be moderately loaded and balanced, and one of the larger weights shifted in different positions upon the edge of one of the pans, and any variation in equilibrium carefully noted. This variation, as previously mentioned, indicates a want of parallelism in the knife edges.

Forms of Single Beam, Equal Arm Balances.—There are good reasons for believing that this kind of balance has a very ancient origin; and at the present time it is used more frequently than any other.

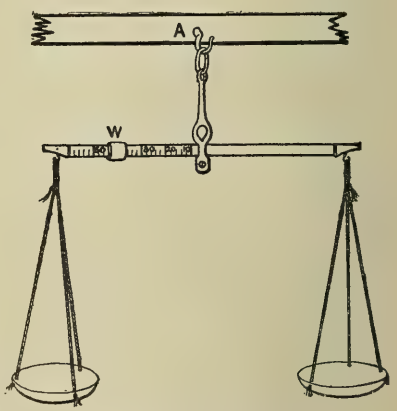
Hand Scales.—The commonest form in which this principle is utilized in pharmacy is seen in the cheap hand scales now fast passing out of use; in the better qualities the beam is of steel, and the knife edges are enclosed so as to protect them from injury. In those usually seen the beam is of brass, with a steel central knife edge, having a perfora-

Fig. 5



Manner of holding scales

Fig. 6



Hand scale with sliding weight

tion in each end of the beam for the insertion of two wire hooks, to which are attached silken cords for supporting the pans. The manner of holding these scales is shown in Fig. 5. They are now most largely employed in America by physicians and pharmacists having a very limited use for a balance. The silken tassel is held in the left hand, and care should always be taken *to see that the beam oscillates freely and properly* before the weight is placed upon the left hand pan, as the hooks frequently become entangled in the cords and the adjustment is lost. The requisite quantity of the substance to be weighed is placed upon the right hand pan, preferably with a spatula.

Alkaloids and very poisonous substances should never be weighed upon ordinary hand prescription scales, except when, by previous actual test at the time, they have been shown to be sensitive and accurate; for, although this form has been in use many years, as now

found in commerce they are the most unreliable of all kinds of prescription balances, and, notwithstanding their merits of cheapness and portability, in the end they may prove (through some serious error) an expensive investment. In Fig. 6 is shown an improved form of hand scale in which a sliding weight is used; this may be suspended on a hook at the proper height as shown in the cut.

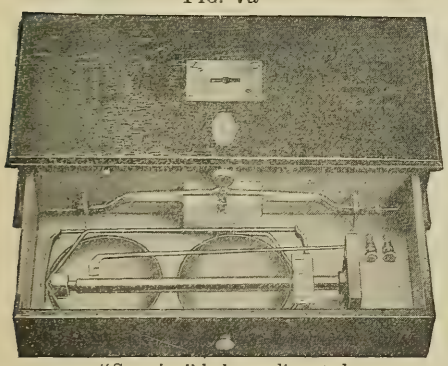
Prescription Balances.—The advantage of substituting a rigid metallic column for the usually unsteady human arm, as a support to the beam, would seem to be apparent at a glance, for, in addition to the increased stability which is gained, both hands are left free to perform the weighing; more time can usually be devoted to secure equilibrium and the oscillations can be more readily noticed.

Fig. 7

"Stansico" dissectible balance

A cheap prescription balance is shown in Fig. 7 and is made by the Standard Scientific Company; the beam, column, supports, pans, etc., are of heavily nickel-plated brass, the knife edges of steel, while the drawer beneath is large enough to hold conveniently all the parts as shown in Fig. 7a; this is a very useful feature where a balance is not in constant use, enabling the operator to set the balance at will, or keep it in the drawer protected from dust and corrosion. It may be made sensitive to the $\frac{1}{24}$ of a grain; but it soon loses this degree of delicacy, because of the rusting of the steel bearings and knife edges. With careful handling, and by protecting it from the atmosphere by covering with a glass shade, or glass case, it will remain in good order for years, and is vastly superior to the hand prescription scales.

Fig. 7a

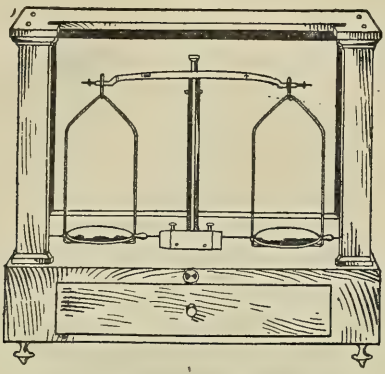


"Stansico" balance dissected

A pharmacist who desires to make use of all the modern improvements and secure the best practical results should have, for *economy's* sake, *two* prescription balances,—one for delicate weighings and the other for ordinary work. These need not have the most fashionable and costly *cases*, but the workmanship of the balance itself cannot be too fine, if by it are secured the absolute essentials of accuracy, sensibility, and durability.

The finest prescription balances are now provided with solid nickel or solid silver pans and gold-plated beams with adjusting screws on the ends to quickly restore equilibrium (see Fig. 8). As the pans are subjected to more wear and tear than any other part of the balance, it is economical to use *solid* rather than *plated* pans, for, constant friction wears off the plating, and the additional cost for replating soon absorbs the difference in price. To secure the best results, when a showy appearance is not desired, a dead black finish to the column is preferable, as the labor of polishing, with the danger to the adjustment that it involves, is dispensed with. Equipped in this way, and with agate bearings, a prescription balance is durable and really cheap, because it will remain for a long time fully equal to the most exacting demands.

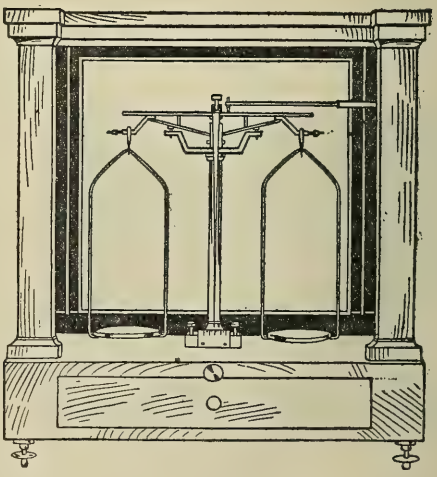
Fig. 8



Fine prescription balance

Analytical Balances.—The growing importance of analytical work renders the possession of an analytical balance by the pharmacist very desirable. American manufacturers now make many excellent forms of such balances. Fig. 9 shows a Troemner analytical balance of recent pattern. The open, metallic beam is light and rigid, the bearings and knives are of agate, and the bows are wide; the pans will each carry 100 grammes and the balance is sensitive to ¼ milligramme. The ends of the stirrups are provided with hooks to suspend a body in taking its specific gravity, and a contrivance for arresting the motion of the beam and pans, together with one for elevating the beam entirely from contact with the agate planes when not in use, is provided.

Fig. 9

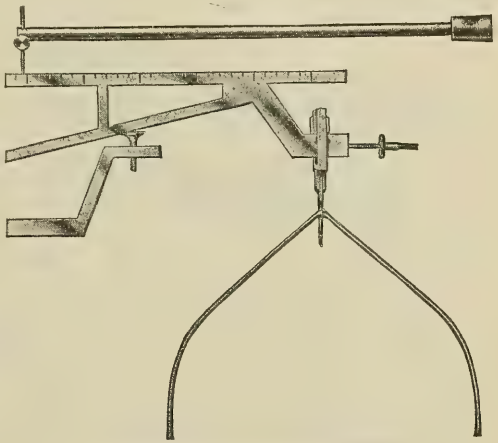


Analytical balance

Fig. 10 shows an enlarged view of the end of the beam with the beam locked. The right arm of the beam is graduated so that each division

represents one-fourth of a milligramme; an aluminum wire rider is pushed along the arm by a sliding rod to any point upon the graduate beam to indicate these fractions. An index needle traverses an ivory scale fixed on the base of the column, and the most delicate oscillations may be thus measured by the needle. If, for instance, *one-tenth of a grain* on one of the pans deflects the needle *ten* divisions on the scale, each one of these divisions would then represent one-tenth of the weight on the pan, or one-hundredth of a grain. With practice, the use of this means of weighing very minute quantities can be brought to great perfection.

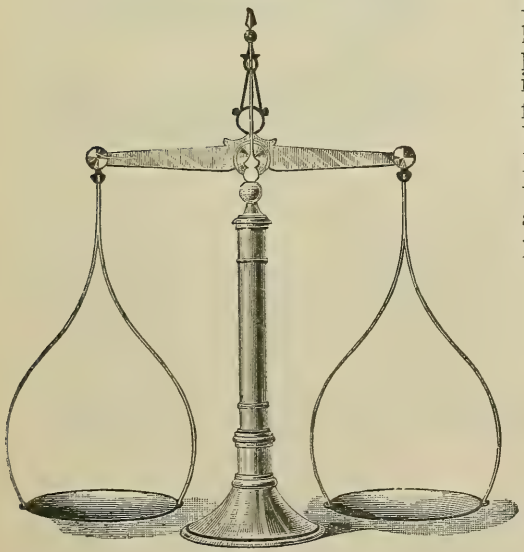
FIG. 10



Enlarged view of the end of beam

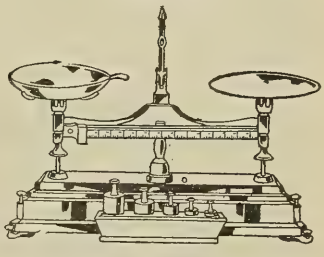
Counter Scales.—For counter and dispensing purposes, the single beam, equal arm principle was formerly exclusively used (see Fig. 11). The form in which the pans are placed above the beam, thus getting rid of obstructive pan supports, is now greatly preferred (see Fig. 17). In these the copper or brass pans alone need polishing. A very convenient form of dispensing scale for smaller weights, made by Troemner, is shown in Fig. 12. This beam is provided with a parallel, graduated bar, upon which a poise slides backward and forward; this is particularly useful for weighing small quantities of liquids. The tare of the bottle is easily taken by the use of the

FIG. 11



Old-style counter scales

FIG. 12

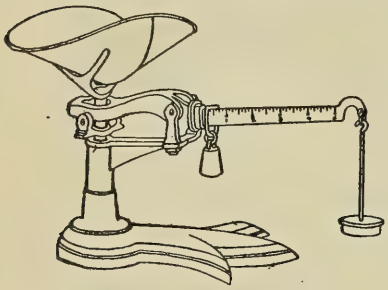


Scale with graduated parallel beam and sliding weight

sliding poise; the beam is graduated so that apothecaries' or metric weight may be used, and a projecting shelf attached to the base forms a convenient receptacle for the weights.

2. Forms of Single Beam, Unequal Arm Balances.—The principle upon which these very practical weighing machines are founded is best shown by referring to Fairbank's druggists' scale (see Fig. 13), and quoting the law in physics, "*The power is to the weight or resistance in the inverse ratio of the length of the arms of the lever.*" The inequality in the length of the arms of this beam permits of the convenient use of one movable weight upon the graduated longer arm of the beam, and thus dispensing with the use of small weights, which are liable to be lost; the scoop, which is useful in weighing bulky drugs, is sometimes replaced by a flat, circular disk when bottles, etc., are to be weighed.

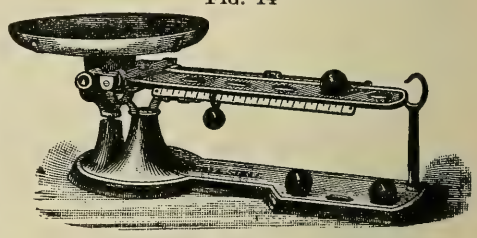
Fig. 13



Fairbank's druggists' scale

Troemner furnishes a convenient scale for pharmacists' use. It is termed the "Ball scale" (see Fig. 14). The beam is flat and perforated with five holes, which are about four inches apart; an iron ball is placed in one of these holes when a substance is to be weighed; the distance from the fulcrum of course determines the weight. It will weigh from $\frac{1}{4}$ oz. av. up to 16 pounds, and is furnished with an extra "sliding poise," to use in taring or balancing bottles when liquids are to be weighed. The purchaser of this scale need not buy a set of avoirdupois weights.

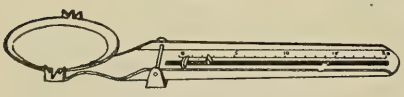
Fig. 14



Ball scale

A very simple vest pocket prescription scale is made by Shepard & Dudley, of New York; it is on the unequal arm principle, and is shown *half size* in Fig. 15. The principal parts are made in three pieces; the pan is detachable, the pan support being suspended on the short rod attached to the base; the graduated beam is more than double the length of the pan support; a slot runs nearly the length of this beam, and a sliding weight is pushed along in the slot. The scale is very cheap, and is intended for country physicians, who are often compelled to weigh medicines at the bedside of the patient.

Fig. 15

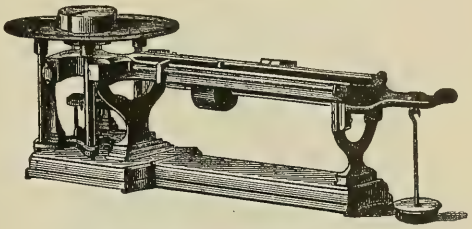


Vest pocket prescription scale

3. Double Beam, Unequal Arm Balances.—It is preferable to have a double beam scale for constant use in the laboratory, and the most

convenient form is upon the same principle as Fairbank's druggists' scale (Fig. 13), having, however, two parallel beams. This scale is particularly adapted for weighing liquids, the weight on the outside beam being used to tare the bottle or jar, while the other weight is left free so that it can be adjusted at once to the weight of the liquid desired. These are now to be had with the scale graduated into grammes, and are very useful in making preparations by the metric system, no loose weights being required when moderate quantities are to be weighed. (See Fig. 16.)

Fig. 16

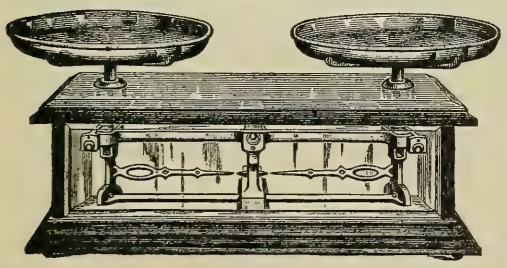


Troemner's scale for weighing liquids

4. Compound Lever Balances.—The principal of the compound lever was first applied in the construction of balances by Robervahl, of Paris, about A.D. 1660. It has only been recently adopted for delicate weighings in compounding prescriptions, although the general utility of counter and platform scales constructed upon this plan has long been recognized. The principal objection to them, when compared with equal beam balances, consists in the multiplicity of points of suspension, thus necessarily increasing friction and the liability to disarrangement; but their general convenience, and some recent improvements in their construction, have brought them into favor. The principle of the Robervahl compound lever balance, with the arrangement of the levers, is shown in Troemner's glass box scale in Fig. 17.

One of the practical advantages possessed by this form of balance is the small amount of polished metal to keep in order, and, as the working parts are enclosed in a tight box of glass, wood, or marble, dust and corrosive vapors are largely excluded; as they are made to occupy as little space as possible, the pans are conveniently low and unobstructed.

Fig. 17

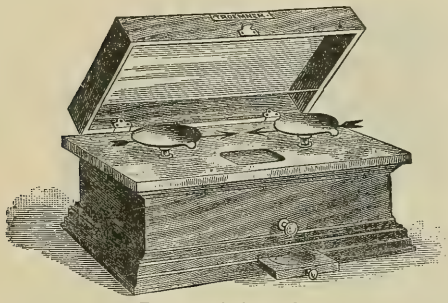


Counter scales in "glass box"

Box prescription scales, on the compound lever principle, have come into extensive use, and they are the most convenient scales for weighing moderately small quantities (see Fig. 18). Although sensitive to $\frac{1}{30}$ of a grain when new, they do not retain this delicacy long. Their strongest recommendation is the ease with which they may be cleaned and kept in order; the only polished metal liable to be affected by corrosive vapors is found in the pans, and these are of solid nickel; the marble or plate glass top has a countersunk basin to keep weights in, and a hinged glass cover effectually excludes dust and vapors when the balance is not in use. If a pharmacist has

a delicate, equal beam balance for weighing alkaloids and powerful poisons (see Fig. 8), and a box prescription scale for weighing ordinary quantities, he is well equipped for compounding prescriptions.

Fig. 18



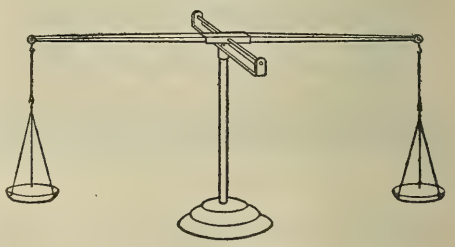
Box prescription scales

By far the most extensive application of the compound lever and unequal arm principles has been made in the universally known platform scales, which are manufactured largely by Fairbank and others; these are employed in weighing comparatively large quantities, and are most useful in the laboratory and warehouse. In these a platform or table is suspended by four short legs upon the ends of four levers, which are joined to a central nearly horizontal lever, which in turn is connected with a perpendicular iron rod attached to the graduated bar, suspended so that one of the arms is much longer than the other. This combination of levers is so nicely adjusted that one hundred pounds placed upon the platform may be balanced by a one pound weight placed upon the end of the graduated bar.

Torsion Balances.—A simple illustration of the principle of torsion is afforded by tying a stout piece of cord to a firm support and inserting a lead pencil in the middle of the cord between the strands, at right angles to it. If the free end of the cord is tightly stretched, and the effort is made to turn the lead pencil over, it will be at once noticed that resistance is offered, and if the pencil is released, it at once flies back to its original position.

Torsion is the term applied to this method of twisting. The principle of supporting the beam of a balance upon a tightly stretched wire, with the view of doing away with knife edges and diminishing friction, has occupied the attention of inventors for years. One of the earliest and simplest forms in which this principle was used was that devised by Ritchie, shown in Fig. 19. A very light beam is supported exactly in the middle (at its centre of gravity) upon a wire stretched upon a horizontal bar, having its ends slightly turned up; to these the ends of the wire are fastened, the beam is firmly secured to the wire, and when it is caused to oscillate the wire is twisted according to the extent of the force applied. This balance was very delicate and impracticable, because the torsional resistance was not overcome; this had to be neutralized before the wire could be used

Fig. 19



Ritchie torsion balance

solely as a means of supporting the beam. In 1882 Prof. Roeder and Dr. Springer contrived an ingenious torsion balance which gave promise of valuable results. Two illustrations of this original balance are shown on page 54 of the first edition of the "Practice of Pharmacy." Recent improvements have greatly increased its efficiency; the most important difficulty in applying the principle—that of torsional resistance—was overcome by the device of placing a weight just above the centre of gravity, torsional resistance having the tendency to keep the beam in a horizontal position, while the elevation of a weight above the centre of gravity, by its tendency to produce

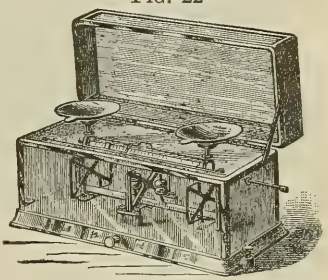
Fig. 20

Frame

Fig. 21

Frame with wire

Fig. 22

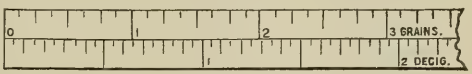


Torsion prescription balance

unstable equilibrium (see page 60), exercises an opposite effect—that of inclining the beam to be top heavy, and therefore to tip on either side. If now the weight be made adjustable, by mounting it upon a perpendicular screw, so that it can be raised or lowered, it is possible to arrange these opposite forces so that one exactly neutralizes the other. In this manner sensitiveness is obtained.

In the torsion prescription balance (see Fig. 22) two beams are used, supported upon three frames, each of the latter having a flattened metallic band stretched tightly over its edge. Fig. 20 shows one of these frames, and Fig. 21 shows a frame with the wire stretched upon it. The form of the prescription balance is that of the box scale, enclosed in a glass case; a rider beam graduated upon the upper edge from $\frac{1}{8}$ of a grain to 8 grains and on its lower edge from 0.5 centigramme to 5 decigrammes (see Fig. 23) furnishes a very convenient means of weighing minute quantities without having to use the small weights. The single ball elevated over the central point of support has in the later patterns been replaced by two smaller weights, one on either side of the central frame. These serve the same purpose as the single weight, and do not have the objection that the latter has, of sometimes interfering with the convenient use of the scales when large pieces of paper are placed upon the scale pans to receive a substance to be weighed (see Fig. 24). A base upon which the torsion balance may be placed, containing a drawer, is very convenient for holding weights, powder papers, etc.

Fig. 23



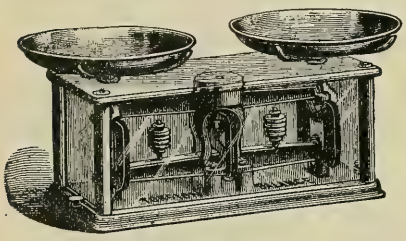
Part of the rider beam

The torsion principle has also been applied to analytical balances with short arms and scales designed to carry heavier loads, as well as counter scales constructed upon the compound lever principle; balances with unequal beams and those having sliding weights

upon graduated beams are now manufactured in many different patterns.

Care of the Balance.—The necessity for protecting the delicate mechanism of a balance is frequently overlooked, notwithstanding the possibility of having a fine apparatus irretrievably ruined by want of care in using or cleaning it or in protecting it while at rest. The position chosen for the balance or scales should be upon a level and firm counter, desk, or table, where it will be subjected to little risk of injury from dampness, dust, or corrosive vapors, and where the knife edges will not be liable to become blunted by the jarring produced by heavy mortar practice or other vibration.

Fig. 24



Torsion counter scale

In the finer class of balances protection is afforded by enclosing them in glass cases having sash doors in the front or at the side, and providing against injury from vibration by the use of a lever for elevating or locking the beam, so that the knife edges are not in contact with any surface whatever. To prevent injury from jarring while the balance is in use, by a weight falling on the pan, or other accident, the finest balances are provided with pan supports, which break the fall and serve the additional purpose of quickly arresting the beam, thus saving time while weighing.

Substances which act on metals, like iodine, corrosive sublimate, etc., and those which are adhesive, like the extracts, should not be weighed directly upon the scale pans, but upon the glass pans which are furnished by the manufacturers, or, if these are not at hand, upon highly glazed paper, care being taken to balance the papers before weighing the substance. In cleaning the scales, great care should be exercised; polishing powders should be used sparingly; a portion is very apt to find its way into crevices and elude detection until an attempt is made to adjust the scales, when the increased weight of one of the sides of the beam leads to its discovery. Frequent cleaning with soft leather is generally sufficient to keep a balance in good order; but if through neglect it becomes necessary to use more active measures, some simple polishing powder for the silver and brass work, with soapsuds for nickel plate, and simple brushing for the lacquered brass, is all that is necessary.

Metallic Weights used in Pharmacy

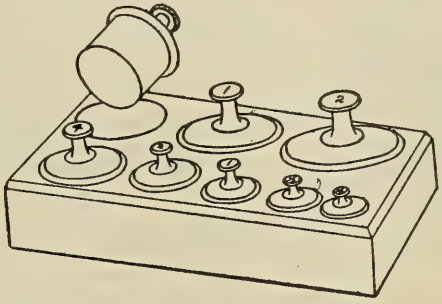
The weights used by the pharmacist are a very important part of his outfit, and care in their selection and examination is necessary. Economy of the cheese paring order is particularly to be avoided, as the use of cheap, inaccurate weights must lead ultimately to serious consequences. Prescription weights are sometimes seen so worn that the characters on their faces have disappeared, and, *per contra*, weights are to be found with bits of hardened extract and dirt obscuring their characters. A set of standard weights should be kept on hand, so that at least once a year the weights in daily use can be tested.

Common avoirdupois weights are usually made of iron, and are of the flat, circular form (see Fig. 25), japanned to prevent rusting; these form a pyramidal pile, and range from half an ounce to four pounds; they may be adjusted by adding to or diminishing the amount of lead

Fig. 25

Common avoirdupois weights

Fig. 26



Avoirdupois weights in metal frame

which is hammered into a depression in the base of each. These weights are sometimes made of brass in this form, and sometimes of zinc; the latter, however, are brittle and unserviceable. When used for dispensing purposes, the cylindrical weights, known technically as "block weights," are preferable. If the block is made of two kinds of wood glued together, so as to avoid shrinkage, they are very desirable, particularly if each cylindrical hole in the block has been made large enough to hold easily each weight. The advantages of block weights are, that the gaps left by missing weights are readily noticed, and the greater surface of the weight is protected from the action of corrosive vapors when not in use. When the weights are nickel plated, a more imposing appearance is produced by arranging them on an ebonized block in recesses. The disadvantage of this form is that the surfaces are not protected from oxidation, and they need cleaning more frequently. J. M. Maris & Co., of Philadelphia, supply brass avoirdupois weights having a shoulder near the top; these fit into circular openings in a hollow cast iron frame (see Fig. 26), and by this expedient the annoyance common to ordinary blocks, caused by the shrinkage of the wood, is avoided.

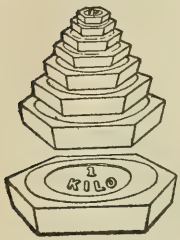
Fig. 27

Cup troy weights

Troy weights may be had either as "block weights" or "cup weights;" the latter are to be preferred, particularly if the block avoirdupois weights have already been procured, for they are then easily distinguished from each other. The cup troy weights range from a quarter of an ounce to thirty two ounces, and have many conveniences (see Fig. 27). When the outside weight is separated, it will be found to have the exact weight of all the rest; if one of the weights is missing, its absence is at once noticed in the incomplete nest; and their compact form is a great recommendation. Weights cannot well be made to occupy less space, while all the inside weights are protected from abrasion and corrosion.

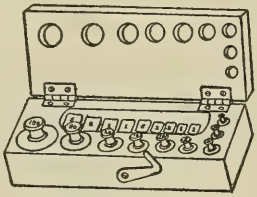
Metric weights may be procured of iron (japanned) for coarse weighing, when they are preferably hexagonal and flat in shape, to distinguish them from the ordinary round avoirdupois weights (see Fig. 28). The most useful for the pharmacist's purposes are undoubtedly the

Fig. 28



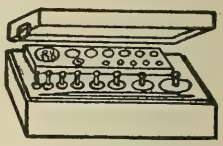
Metric weights (iron)

Fig. 29



Metric weights (block)

Fig. 30



Metric weights (analytical)

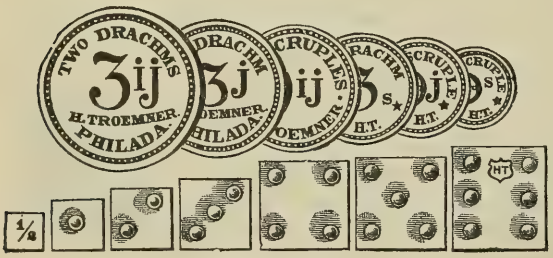
brass weights. Those made by Becker, and contained in a solid block, ranging from one centigramme to one hectogramme, as shown in Fig. 29, are very reliable and convenient.

For prescription purposes, a very inexpensive yet accurate set is made by Troemner, by which as high as forty grammes may be weighed by using all the brass weights, while ample provision is made for weighing the fractional parts of a gramme.

For analytical purposes, metric weights are almost exclusively used; in the most complete sets the highest weight is one kilogramme, the lowest one-tenth of a milligramme; three riders for use on the graduated scale beam are provided. The weights, from one gramme upward are of brass, finely lacquered; the smaller weights are made of squares of platinum foil, curved so as to permit of being easily handled with the forceps.

Prescription weights.—Too much care can hardly be exercised in the selection of weights to be used in compounding prescriptions. The cost of accurate weights is trifling, yet the market is flooded with weights which are disgracefully inaccurate, and it is greatly to be regretted that the latter find a ready sale. The round, flat, brass "drachm" weights, which have the denomination stamped distinctly on their face in raised characters, are most largely used (see Fig. 31). These range from ten grains to one hundred and twenty grains in weight. The old fashioned square brass "drachm" weights are rapidly passing out of use. The brass foil grain weights are usually inaccurate, and should not be employed, because of their liability to corrosion. Undoubtedly the best grain weights are the alu-

Fig. 31



Prescription weights

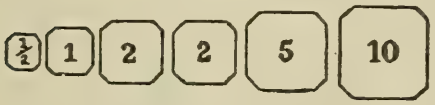
minum wire weights. These are more easily and quickly distinguished from one another than any other form, and there is less likelihood of dangerous mistakes than from the flat weights, where the denomination is stamped upon the face, often faintly, and is liable to be obliterated by constant use or corrosive contact. The number of sides in the wire weights at once gives the denomination (see Fig. 32). There is such a difference in the shape of these weights, and they are so simply handled practically, that they should be invariably used. The aluminum grain weights, cut out of aluminum plates, are to be preferred to the flat, brass grain weights, because less liable to corrosive action. They are usually more accurately adjusted ; the corners of the weights are clipped, and each weight is pressed into a curved form, so that it may be easily picked up (see Fig. 33).

Fig. 32

Aluminum wire weights

Measuring Liquids.—Tinned iron measures nearly cylindrical in shape, but slightly wider at the bottom, are generally used for measuring liquids when the quantity is over a pint. A set of these measures usually consists of four (gallon, half-gallon, quart, and pint). Those made of tinned iron, or of the enamelled sheet iron called agate or marbleized, are greatly inferior to those made of *tinned copper*. Tinned iron measures soon become rusty ; and although a protection is afforded if enamelled, particles of the enamel become chipped off, and the exposed iron soon contaminates the liquids measured in them. Tinned copper measures cost more at first, but they are more economical, because more durable. Care must be taken to protect them from blows which will cause dents, as these may be serious enough to detract from the accuracy of the measures. Fig. 34 shows a copper gallon measure of the usual form. Cylindrical metric measures having a diameter just half their height, of tinned copper or brass, in sets of ten, including dekaliter, half-dekaliter, double liter, liter, half-liter, double deciliter, deciliter, half-deciliter, double centiliter, and centiliter are obtainable. An excellent measure for the laboratory, particularly where liquids are to be carried any distance, is shown in Fig. 35. It was designed by Dr. E. R. Squibb, and has the merit of being less liable to error in measuring than those of ordinary shape, because of the contracted surface at the top.

Fig. 33



Aluminum grain weights

Fig. 34

Tinned copper gallon measure

Fig. 35

Laboratory measure

Glass measures are preferred for relatively small quantities of liquids, for, although always subject to loss by fracture, they can be more accurately adjusted to indicate the measure. On account of the trans-

parency of glass, the level of the liquid at any height may be seen through the measure, while porcelain or metallic measures have to be full, or nearly so, to be used.

Fig. 36

Tumbler-shaped graduate

Fig. 37

Metric graduate

Fig. 38

Cylindrical graduate

Glass graduated measures are almost exclusively used for quantities of one pint or less, and these are of two forms,—*conical* and *cylindrical*. The conical graduate is preferred in practical work because of the greater ease with which it can be cleansed, but cylindrical measures are likely to be more accurate because of their smaller diameter. Thus, if a conical graduated measure has at the f℥ 3 mark a diameter of 3 inches (see Figs. 36 and 37), and the cylindrical graduate (see Fig. 38) a diameter at the same mark of 1 inch, it follows that a trifling error in reading off in the cylindrical graduate, either slightly above or below the line, would be increased if similarly made in the conical graduate by exactly the number of times that the surface of the liquid in the conical graduate exceeds that in the cylindrical graduate at the given point. Formerly it was usual to use exclusively glass measures which had been graduated by hand; but, owing to the large quantities of imperfect graduates found in the market, moulded measures came into use. These, while deficient in the attractive brilliancy of surface characteristic of blown glass, have the substantial merit of greater accuracy. Hodgson's moulded graduated measures were the first to appear, and were largely used for a while, but they have been supplanted by Hobb's graduated measures. In Hodgson's measure the graduations are upon the outside surface of the glass, and their accuracy largely depends upon whether the plunger, which forces the melted glass into the mould, is driven down to exactly the standard depth to secure the proper thickness of glass to indicate the correct capacity. This practical point could not always be attained, owing to the wear of the mould, and occasionally the measures were imperfect. In Hobb's graduated measures this difficulty is overcome by *graduating the plunger*, and when this is done it makes no difference about the thickness of the glass, because if the plunger is correctly graduated, if the proper allowance has been made for contraction in cooling, and if a correct impression can be made upon the inside of the glass, the measure itself must be accurate, and the same result can be indefinitely repeated. An objection arises, however, to this form of graduate in measuring thick or dark colored liquids, for then the graduations upon the inside are often completely obscured. This is sometimes remedied by correspondingly marking them upon the outside with an engraver's wheel. The introduction of the moulded graduates has had the natural effect of improving the accuracy of the blown, hand graduated measures, and it is now unusual to see a measure like one formerly in the possession of the author, which registered 25 per cent. too much when filled to the highest graduation. If the custom of returning to the

Fig. 39

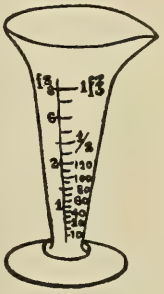
Graduate hook

maker all graduates which prove inaccurate were universal, it would soon be impossible to find an inaccurate one. As it is, reliable graduates can always be had by paying a fair price for them.

Fig. 39 shows a simple method of supporting a graduate after cleaning it. A brass hook is screwed into an upright, preferably over the sink ; the prongs are so adjusted that they easily catch the graduate base.

An improvement has been made recently by graduating measures *doubly ;* upon one side metric measures are marked, and upon the other ordinary fluid measures, and in addition they sometimes have two lips opposite to each other, for pouring either to the right or left, or for permitting the use of either scale. The testing of the graduation of a glass measure is effected most accurately by placing it upon a perfectly level surface and then pouring into it the proper weight of distilled water at the temperature of 25° C. (77° F.) ; the fluidounce, weighing 454.6 grains, is preferably taken as the basis. A sufficiently accurate and more ready method is to measure into the graduate from a standard burette or pipette 30 mils of water for a fluidounce (29.57 mils is the exact equivalent). The extension of the graduating mark into a circle which passes entirely around the graduate is an improvement which obviates the necessity of placing the graduate upon a level place, as the corresponding mark upon the opposite side may be seen through the glass, and the graduate easily levelled even when held in the hand. For measuring smaller quantities of liquids graduated glass tubes of much less diameter should be used, and minim pipettes are more accurate, cleanly, and convenient than the conical minim graduates which are often used, and which possess several radical faults. By referring to Fig. 40 it will be seen that the graduations on the minim measure are necessarily in the narrowest and lowest portion of a comparatively tall measure. Now, if it is desired to measure ten minims of a volatile oil, to add to a pill mass, the surface which the oil must traverse when this measure is inverted over the mortar is so great that probably 20 per cent. of the oil will be left adhering to the measure. In those instances of liquid preparations where the smaller liquid is miscible with the larger quantity of diluting liquid, the minim graduate may be rinsed and this loss recovered, but inconveniences are largely overcome and greater accuracy secured by the use of the minim pipette suggested by Dr. E. R. Squibb (see Fig. 41). This in its simplest form consists of a glass tube of small caliber, with its lower extremity somewhat contracted, and having minim graduations upon its side. The pipette is used by dipping the contracted end into the liquid to be measured, and upon applying suction by the mouth at the opposite end the liquid is drawn into the pipette ; the moistened tip of the right forefinger is now tightly applied to the upper end of the tube to regulate the flow of the liquid, and a sufficient quantity is allowed

Fig. 40



Minim measure

Fig. 41

Minim pipette

to flow out by slightly raising the finger until the height of the liquid corresponds to the measure desired ; pressure with the forefinger at once stops the flow, and the accurately measured quantity can be transferred to the bottle, mortar, or graduate by raising the finger and allowing the liquid to flow out. These pipettes may be had of four different capacities, holding 15, 20, 30, and 60 minims, and a reference to the cut will show that a sufficient length of tube above the graduations is left to secure the operator from any risk of getting a poisonous liquid into the mouth, except through extraordinary carelessness. One of the best methods of keeping the pipette ready for use is to have it pass through a perforated cork which fits into a half-pint bottle containing alcohol or water (see Fig. 42), the liquid being renewed when it ceases to be clean. A rubber unperforated tube nipple, inserted on the top of the pipette, has also been suggested to obviate the necessity of using suction with the mouth ; it is used by first pushing it down over the top of the pipette until it will go no farther, then compressing the bulb and inserting the tip of the pipette into the fluid, when upon gradually relieving the pressure on the bulb the pipette commences to fill, and if not filled to the mark desired the bulb is pushed upward gently until the end is attained. In the use of tubes or glass measures of small diameter, it will be noticed that two distinct lines are visible on the surface of the liquid. This is due to the capillary attraction of the glass, which causes the edge of the liquid to creep up the sides, and the surface becomes concave and a *meniscus* is formed ; the lowest point of the lower zone is usually selected by analytical chemists as the reading point, but it is manifest that a line drawn between the upper and lower zones slightly below the middle would give the most correct reading. Fortunately, the occasions are very rare in pharmaceutical operations where a difference in the method of reading need cause concern.

FIG. 42

Minim pipette with bottle

In administering small quantities of liquids the very convenient *drop* is almost always used. The impression that a drop is equivalent to a minim, and that sixty drops of any fluid are equivalent to a fluidrachm, is widespread. This impression doubtless arose from the fact that sixty ordinary drops of *water* are about equal to a fluidrachm ; but many circumstances cause variations in the relative size of drops. Thick viscous liquids, like the mucilages and the syrups, necessarily produce large drops, because the drop adheres to the surface of the glass so long as its weight does not overcome its power of adhesion, while bromine and chloroform, heavy, mobile liquids, having very little adhesion to the dropping surface, produce very small drops, only one-fifth the size of the drop of syrup of acacia. The shape and surface of the vessel from which the liquid is dropped also have an influence in determining the size of the drop. The greater the extent of surface for the drop to adhere to, the larger, proportionally, will be the drop. In order that this subject should have an investigation of a rather wide range, the late Stephen L. Talbot, at the author's suggestion, constructed, after many laborious trials, the following table :

Table exhibiting the Number of Drops in a Fluidrachm of Different Liquids, with the Weight in Grains and Grammes

Name	Drops in fʒi (60 m.)	Weight of fʒi	
		in gr.	in Gm.
Acetum Opii	90	61	3.95
Sanguinariæ	78	55½	3.59
Scillæ	68	57	3.69
Acidum Aceticum	108	58	3.75
Aceticum Dilutum	68	55	3.56
Carbolicum	111	59	3.82
Hydrochloricum	70	65	4.21
Hydrochlor. Dilutum	60	56	3.62
Hydrocyanicum Dil.	60	54	3.49
Lacticum	111	66	4.27
Nitricum	102	77	4.98
Nitricum Dilutum	60	58	3.62
Nitrohydrochloricum	76	66	4.27
Phosphoricum Dil.	59	57	3.69
Sulphuricum	128	101	6.54
Sulphuricum Aromat.	146	53	3.43
Sulphuricum Dilutum	60	58½	3.79
Sulphurosum	59	55	3.56
Æther	176	39	2.52
Alcohol	146	44	2.85
Dilutum	137	49	3.17
Aqua	60	55	3.56
Ammoniæ Fortior	66	50	3.24
Destillata	60	53½	3.46
Balsamum Peruvianum	101	60	3.88
Bromum	250	165	10.69
Chloroformum	250	80	5.18
Copaiba	110	51	3.30
Creosotum	122	56½	3.66
Fluidextract Belladon.	156	57	3.69
Buchu	150	47½	3.07
Cimicifugæ	147	48	3.11
Cinchonæ	138	58	3.75
Colchici Radicis	160	57	3.69
Colchici Seminis	158	55	3.56
Conii	137	61	3.95
Digitalis	134	62	4.01
Ergotæ	133	60	3.88
Gelsemii	149	49	3.14
Glycyrrhizæ	133	61	3.95
Hyoscyami	160	59	3.82
Ipecacuanhæ	120	60	3.88
Pareiræ	140	57	3.72
Rhei	158	61	3.95
Sarsaparillæ Comp.	134	60	3.88
Senegæ	137	62	4.01
Serpentariæ	148	47	3.07
Uvæ Ursi	137	60	3.88
Valerianæ	150	49	3.17
Veratri Viridis	150	50	3.24
Zingiberis	142	48	3.11
Glycerinum	67	68	4.40
Hydrargyrum	150	760	49.24
Liquor Acidi Arsenosi	75	56	3.62
Ammonii Acetatis	57	55	3.56
Arseni et Hydrargyri Iodidi	58	55	3.56
Ferri Chloridi	71	72	4.66
Ferri Citratis	71	72	4.66
Ferri Nitratis	59	59	3.82
Ferri Subsulphatis	73	83	5.37
Ferri Tersulphatis	83	72	4.66
Liquor Hydrarg. Nit.	131	123	7.97
Iodi Compositus	63	59	3.82
Plumbi Subacetatis	74	70	4.53
Potass. Hydroxidi	62	58	3.75
Potassii Arsenitis	57	55	3.56
Sodæ Chlorinatæ	63	62	4.01
Zinci Chloridi	89	88	5.70
Oleoresina Aspidii	130	52	3.36
Capsici	120	51	3.30
Cubebæ	123	52	3.36
Oleum Æthereum	125	50	3.24
Amygdalæ Amaræ	115	55	3.56
Amygdalæ Expres.	108	48½	3.14
Anisi	119	54	3.49
Bergamottæ	130	46	2.98
Cari	132	50	3.24
Caryophylli	130	57	3.69
Cinnamomi	126	53½	3.46
Copaibæ	123	49½	3.20
Cubebæ	125	51	3.30
Fœniculi	125	53	3.43
Gaultheriæ	125	62	4.01
Juniperi	148	49	3.17
Lavandulæ	138	52	3.36
Limonis	129	47	3.04
Menthæ Piperitæ	129	50	3.24
Ricini	77	51½	3.33
Rosæ	132	47	3.04
Rosmarini	143	50	3.24
Sassafras	133	58	3.75
Terebinthinæ	136	45½	2.94
Tiglii	104	50	3.24
Spiritus Æther. Comp.	148	45	2.91
Ætheris Nitrosi	146	47	3.04
Ammoniæ Aromat.	142	48	3.11
Camphoræ	143	47	3.04
Chloroformi	150	48	3.11
Menthæ Piperitæ	142	47	3.04
Syrupus	65	72	4.66
Acaciæ	44	73	4.73
Ferri Iodidi	65	77	4.98
Scillæ	75	74	4.79
Scillæ Compositus	102	70	4.53
Senegæ	106	70	4.53
Tinctura Aconiti	146	46	2.98
Belladonnæ	137	53	3.43
Benzoini Composita	148	48	3.11
Cantharidis	131	51	3.33
Cinchonæ Comp.	140	49	3.17
Digitalis	128	53	3.43
Ferri Chloridi	150	53	3.43
Iodi	148	47	3.04
Nucis Vomicæ	140	44	2.85
Opii	130	53	3.43
Opii Camphorata	130	52	3.36
Opii Deodorati	110	54	3.49
Valerianæ	130	52	3.36
Veratri Viridis	145	46	2.98
Zingiberis	144	46	2.98
Vin. Colchici Radicis	107	55	3.56
Colchici Seminis	111	54	3.49
Opii	100	55	3.56

Specific Gravity

A knowledge of the subject of specific gravity is necessary to the pharmacist, to enable him to identify substances or to judge of their purity, while the physician frequently depends upon it as an aid in diagnosing certain diseases. *Specific gravity is the weight of one body compared with the weight of an equal bulk or volume of another body selected as the standard, both bodies having the same temperature.* In ascertaining the ordinary weight of a body it is simply compared with an arbitrary standard selected by governmental authority, while in determining specific gravity, the body, if solid or liquid, is compared with a standard which is universal,—*i.e.*, an equal bulk of pure water expressed as 1 and taken at a given temperature[1] and atmospheric pressure. In all the methods hereafter detailed, it must be borne in mind that the main object sought for *is the weight of a bulk or volume of water equal to that of the body of which we wish to take the specific gravity.* Archimedes proved experimentally that *a body immersed in a liquid lost as much weight as its own bulk of that liquid weighed;* hence is derived the general rule for taking specific gravity :

Rule.—Divide the weight of the body by the weight of water displaced (loss of weight in water); the quotient will be the specific gravity.

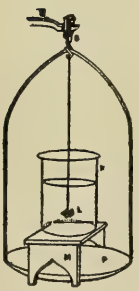
The taking of specific gravity will be considered as follows :

1. Solids insoluble in, but heavier than water.
2. Solids soluble in, but heavier than water.
3. Solids insoluble in, but lighter than water.
4. Solids soluble in, but lighter than water.

1. To take the specific gravity of a solid insoluble in, but heavier than water.

a. With the Balance.—It is customary to recommend a special balance for taking the specific gravity of solids, known technically as the hydrostatic balance ; but a good prescription or analytical balance will answer perfectly for practical purposes. The substance, preferably in one piece, is first weighed accurately and the weight noted ; a horse hair is then tied around it with a slip knot, and a tight loop at the other end is made, which is attached to the hook at the end of the scale beam ; a small wooden bench made for the purpose, or extemporized by taking out the bottom and one of the sides of a small wooden or stiff pasteboard box, is now arranged over the scale pan so that it does not touch it or interfere with its free movement ; upon this a small beaker or wide mouthed jar is placed, and two-thirds filled with pure water (see Fig. 43). The horse hair must be adjusted to such length that it will permit of the complete immersion of the substance in the water. Upon weighing the immersed substance, after freeing it from attached air bubbles, it will be at once noticed that it has lost weight, and all that remains to

Fig. 43



Taking the specific gravity of a solid

[1] The temperature directed in the U. S. P. IX is 25° C. (77° F.). When not specified, it is understood to mean 25° C. (77° F.); but in many investigations, particularly those conducted in Europe, the temperature selected is that of the maximum density of water, 4° C. (39.2° F.). For practical purposes the temperature adopted by the Pharmacopœia is most useful in the latitude of the United States.

be done is to apply the rule,—divide the weight of the body by its loss of weight in water.

For example, 805.5 grains of copper lose by immersion in water 90 grains; then 805.5 divided by 90 gives 8.95, the specific gravity of the copper. See also Nicholson's hydrometer, page 88.

b. With the Specific Gravity Bottle.—This instrument in its most usual form is a bottle having an elongated, narrow neck, fitted with a ground glass stopper, and holding, when filled, exactly 1000 grains of pure water at a given temperature (see Fig. 44).[1] The reason for selecting 1000 grains for the contents is to avoid the necessity of making a calculation to obtain the specific gravity of a liquid.[2] To use the instrument for a solid substance, the previously weighed body is dropped into the bottle, which is then filled with water at the temperature of 25° C. (77° F.), the bottle carefully dried, and, after the counterpoise (the exact weight of the empty bottle, see Fig. 45) has been placed upon the opposite scale pan, it is weighed. To obtain the *loss of weight* in water of the substance, it is only necessary to deduct the weight of the contents of the bottle (*i.e.*, that of the water and the immersed body) from the weight of the body in air, plus that of the water which the bottle holds when full,—*i.e.*, 1000 grains; the rule is then to be applied,—divide the weight of the body by its loss of weight in water.

Fig. 44

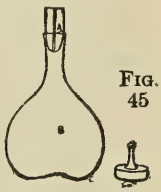
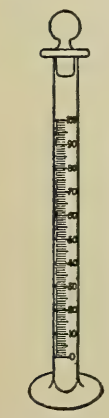


Fig. 45

1000 grain bottle with counterpoise

Example.—A piece of aluminum wire weighs 100 grains; when dropped into a 1000 grain bottle, and the bottle filled with water at the proper temperature, the weight of both is 1062 grains. As the bottle when filled with water alone held 1000 grains, and as the weight of the aluminum in air is 100 grains, both together weigh 1100 grains; hence 1100 grains, less 1062 grains, gives 38 grains, the loss of weight of the aluminum in water. *Apply the rule,* $\frac{100}{38} = 2.63$, sp. gr. The specific gravity of any insoluble powder, like calomel, litharge, etc., may be taken in exactly the same way, but care must be observed to agitate the powder with a small quantity of water in the bottle, before adding the rest, to cause the bubbles of air to escape.

Fig. 46



Graduated specific gravity tube

c. With the Graduated Tube.—A graduated tube is provided in which each space indicates a grain or a gramme (mil) of water (or better if graduated in smaller subdivisions); the zero mark should be somewhat above the bottom of the tube, as shown in Fig. 46. Now, if water be poured into the tube exactly up to the zero mark, and a weighed solid body dropped into it, the water will rise in the tube and indicate the weight of a bulk of water equal to that of the substance; this is equivalent to the loss in water. *Then apply the rule,*—divide the weight of the body by its loss of weight in water. It is evident that this method cannot be as accurate as either of those above mentioned, as small differences are more clearly indicated by a good balance than by tube reading.

[1] 50 Gramme Specific Gravity bottles are supplied by apparatus dealers for those who prefer metric bottles.

[2] See Specific Gravity of Liquids, page 81.

d. By immersing the Solid in a Transparent Liquid of the Same Density.—This method may be applied where the body is small, is not very heavy specifically, and is insoluble in the liquid. A heavy liquid is chosen, like solution of mercuric nitrate; the solid is found to float on the surface of the liquid, and water is added until the solid neither rises nor sinks, but swims indifferently. The specific gravity of the solid will of course be that of the liquid, which may be ascertained by the specific gravity bottle (see page 81).

2. To take the specific gravity of a solid soluble in, but heavier than water.

A liquid must be selected in which the solid is insoluble, like olive oil, almond oil, petroleum benzin, or oil of turpentine. The specific gravity of the oil having been ascertained, it is used just as if it were water, the object being to find out the loss of weight that the substance suffers when immersed in the oil; this having been obtained, a simple proportion must be made as follows: as the specific gravity of the oil is to the specific gravity of water, so is the loss of weight in the oil to the loss of weight in water. *Then apply the rule,*—divide the weight of the body by its loss of weight in water.

Example.—200 grains of citric acid lose by immersion in oil 115 grains; then, as

Sp. gr. of oil		Sp. gr. of water		Loss of weight in oil		Loss of weight in water	
0.920	:	1.000	::	115	:	125	$\frac{200}{125} = 1.6$, sp. gr. of citric acid.

It is obvious that either the balance, specific gravity bottle, or graduated tube can be used in this case; but it is possible in some cases to coat the soluble substance with varnish and treat it then as an insoluble substance, and thus avoid the use of an oily liquid. A pill of blue mass may be coated with shellac varnish, and then treated as an insoluble substance as in 1, *b*. The practical difficulty, however, is to secure a thin coating which shall be impervious to water.

3. To take the specific gravity of a solid insoluble in, but lighter than water.

The solution of this problem requires the aid of a heavy insoluble body, which is to be attached to the light body, so as to secure the immersion of both. It is plain that if the loss of weight in water of the heavy substance is deducted from the loss of weight in water of both the heavy and the light body, the result must give the loss of weight in water of the light body alone. *Then the rule must be applied,*—divide the weight of the body by its loss of weight in water.

Example.—A piece of paraffin weighs 174 grains, a piece of brass loses by immersion in water 6 grains; when the brass is attached to the paraffin, both together lose by immersion in water 206 grains; by deducting 6 grains (the loss in water of the brass) from 206 grains (the loss in water of both) the loss in water of the paraffin alone is found,—*i. e.*, 200 grains; then $\frac{174}{200} = 0.870$, sp. gr. of paraffin. See also Nicholson's hydrometer, Fig. 57.

4. To take the specific gravity of a solid soluble in, but lighter than water.

The use of the specific gravity bottle is recommended in cases of this kind, and the process is the same as in 2. The selection of a

suitable liquid lighter than the body, and in which it is insoluble, is, however, usually attended with difficulty. The proportion would be, as the specific gravity of the light liquid is to the specific gravity of water, so is the loss of weight in the light liquid to the loss of weight in water. *Then the rule must be applied,*—divide the weight of the body by the loss of weight in water.

Specific Gravity of Liquids

The *specific gravity bottle* (*pycnometer* or pyknometer) is the most accurate instrument for taking the specific gravity of liquids. Fig. 47 shows a practical form; it is used as follows. The liquid to be tested is first brought to the proper temperature, 4° C. (39.2° F.), 15.6° C. (60° F.), or 25° C. (77° F.), according to the standard selected for the bottle; the bottle is filled with the liquid to the mark on the neck, dried carefully, and weighed accurately, using the counterpoise on the opposite pan. If the 1000 grain or 100 gramme bottle has been used, the weight of the liquid at once indicates the specific gravity. Thus, the bottles would hold at 25° C. (77° F.) 1158 grains or 115.8 grammes of hydrochloric acid, 1246 grains or 124.6 grammes of glycerin, 716 grains or 71.6 grammes of ether, and 13535 grains or 1353.5 grammes of mercury, and the specific gravity of each would be respectively 1.158, 1.246, 0.716, and 13.535, thus directly showing the relation to the specific gravity of water, 1. To show the use of an ordinary prescription vial in this process, one containing about a fluidounce may be taken; if it holds 454.6 grains of pure water to a mark upon the neck it will be convenient, because it will at the same time give the weight of a fluidounce of the liquid. It is evident that a bottle holding any moderate quantity may be used in the same way.

FIG. 47

Specific gravity bottle

A fluidounce bottle at 25° C. (77° F.) would hold 526.4 grains of hydrochloric acid, 566.5 grains of glycerin, 325.5 grains of ether, and 6153.0 grains of mercury, and the specific gravity would be obtained by the following proportion:-

Example.—As 454.6, the number of grains of pure water that the bottle holds, is to 1.000, the specific gravity of water, so is 526.4, the number of grains of hydrochloric acid that it holds, to 1.158, the specific gravity of hydrochloric acid. 454.6 : 1.000 : : 526.4 : 1.158.

In practice, it is simply necessary to divide the number of grains of liquid that the bottle holds by 454.6 and adjust the decimal point. The accuracy of these bottles depends entirely upon the care with which they are made and used, and it is better to scratch, with a file, two marks upon the neck of a long necked flask, one showing the upper edge of the meniscus and the other marking the lowest point (see Fig. 47). In filling, it is a good practice, after bringing the liquid to the proper temperature, to exceed slightly the quantity indicated by the mark on the neck, and then to make a small roll of filtering paper and neatly absorb the excess by inserting the roll in the neck so that it shall just touch the surface. The more expensive specific gravity bottles have an accurately fitted stopper made of thermometer tube, and hold exactly 100 grammes, or 1000 grains, when the bottle, including the capillary tube of the stopper, is en-

tirely full (see Fig. 44). They are not so convenient as a correctly marked, narrow necked bottle (see Figs. 47 and 49), nor are they practically more accurate. They have to be filled to the brim and the stopper then inserted; this causes an overflow, and the necessary wiping and the natural warmth of the hands usually expand the liquid by raising the temperature, and prevent accurate results.

Fig. 49

Fig. 48

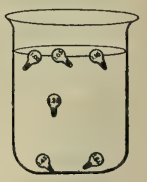
Squibb's pycnometer with leaden collar

A more elaborate form of apparatus for taking specific gravity is needed for some purposes; for instance, where standards are required for the liquid preparations of the Pharmacopœia or in investigations where great accuracy is necessary. Dr. Squibb has devised the pycnometer shown in Fig. 49, which is admirably adapted for taking specific gravity with the objects above mentioned.

One of these bottles is shown in the illustration; the stopper is a tube lengthened out so that the central channel will permit the bottle to hold the volume of water at any temperature between 4° C. (39.2° F.) and 25° C. (77° F.), thus permitting any of the standards of temperature to be used, the tube being graduated to half-millimeters, and at the top it is enlarged so as to allow room for the expansion of light liquids and to permit the bottle to be loosely closed with a cork while adjusting the temperature, the cork being removed during the weighing. These bottles are all used in a bath of water containing ice when the lower standard temperatures are used; Fig. 48 shows a leaden collar to keep the bottle in position in the bath.

It is necessary to verify the marks of the contents of the bottles from time to time, as the glass flask contracts for a year or two after it has been made. The liquid that it is designed to test is weighed into the bottle, as in the ordinary cases of taking specific gravity; the bottle is loosely corked, loaded with the leaden collar, and set in a bath of water which has been brought to the desired temperature. When the liquid in the bottle has reached the same temperature (and this is indicated by the liquid in the tube remaining stationary, a careful watching of the rise or fall of the liquid in the graduated tube being necessary in order to determine this), the final adjustment is made and the bottle weighed.

Fig. 50



Lovi's beads

Lovi's beads, or *specific gravity beads*, are sometimes used for taking the specific gravity of liquids; they are especially useful in cases where a boiling liquid is to be evaporated until it has a given specific gravity, and in mixing liquids of different densities. They are balloon shaped, hollow globes of glass, of different sizes and weights, having specific gravity figures scratched upon their sides. These figures indicate the specific gravity of a liquid in which the beads swim indifferently; they neither rise nor sink, when not disturbed at the given temperature, if the specific gravities of the bead and liquid are the same. The illustration, Fig. 50, shows their method of use, those heavier than the liquid sinking, those lighter floating,

while the one supported indifferently (1.25) indicates the specific gravity of the liquid. Lovi's beads may be defined as hydrometers which indicate but one specific gravity.

Hydrometers

Hydrometers, sometimes called *areometers*, are floating instruments which are used to indicate the specific gravities of liquids by sinking to a depth corresponding to the densities of the liquids. Their principle of action was probably first made known by Archimedes, and depends upon the fact that when a solid body is placed in a liquid in which it is capable of floating, it sinks to a certain point, and this floating point is reached when the body has displaced a volume of liquid exactly equal to its own weight. Thus, if an hydrometer has a specific gravity exactly three-fourths that of water, it will sink in water until exactly three-fourths of its volume is immersed ; the same hydrometer would swim indifferently, like a Lovi's bead, in ether having the specific gravity of 0.750, for the obvious reason that the specific gravities of the solid and liquid are identical. Hydrometers may be divided into two classes for convenience of study : 1. Those in which the weight is constant, but the depth of immersion subject to change. 2. Those in which the depth of immersion is constant, but the weight subject to change. To the first class belong nearly all the hydrometers specially useful to pharmacists, and of these, two kinds are generally used, one for liquids heavier than water, the other for those lighter. They are known as Baumé's, Cartier's, Gay-Lussac's, Zanetti's, Twaddell's, but the best of all is the specific gravity scale hydrometer. To the second class belong the hydrometers which are intended to sink, by the addition of weights, to a given mark on the stem, and thus displace a constant volume, like Fahrenheit's, Nicholson's, Guyton de Morveau's, etc.

Fig. 51

Baumé's hydrometer

1. Hydrometers in which the weight is constant, but the depth of immersion subject to change.

Baumé's Hydrometers.—This form is treated first in detail because it was the first one of its class to come into general use, having been originally described by Baumé in his "Éléments de Pharmacie." Two instruments were used by Baumé, one termed *Pèse-Acide* or *Pèse-Sirop*, for liquids heavier than water, the other *Pèse-Esprit*, for liquids lighter than water. This hydrometer, as now made, consists of a glass tube loaded at the bottom with mercury or small shot, having a bulb blown in it just above the loaded end. (See Fig. 51.) A simple cylindrical tube, loaded so as to cause it to assume an upright position in a liquid, may be used as an hydrometer. The only advantage gained in expanding the lower portion into bulbs is one of convenience, that of increasing the volume of the hydrometer, and thus permitting the use of shorter instruments. The graduations upon the stem of Baumé's hydrometer are entirely arbitrary, and were made in the following manner :

For the hydrometer to be used for *liquids heavier than water*, sufficient mercury was added to the lower bulb to cause it to sink in water to a convenient point near the top of the stem; this was marked 0. The instrument was then placed in a solution containing 15 per cent. by weight of common salt, and the point at which it rested was marked 15. The space between these two points was divided into fifteen *equal* parts, and the scale below was extended by marking off similar spaces. *For liquids lighter than water*, the instrument was placed in a 10 per cent. by weight solution of common salt, and loaded so that it floated at a point just above the bulb; this was marked 0. The hydrometer was then transferred to water, the point at which it rested was marked 10, the space between was divided into ten equal parts, and the scale above was extended by marking off similar spaces. The illustrations, Figs. 52, 53, were drawn from Pile's hydrometers, and show the manner of graduating the Baumé scale for both hydrometers, and, in addition, the corresponding specific gravity figures. The Baumé hydrometer is rapidly going out of use, being replaced by an hydrometer having a graduated scale, in which the graduations represent the specific gravities.

Fig. 52

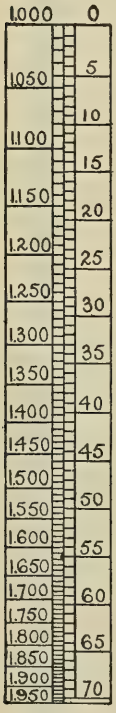
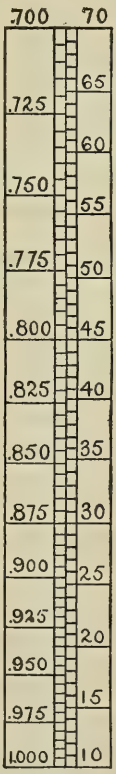


Fig. 53



Scales of specific gravity hydrometer

The specific gravity scale hydrometer, which should be used exclusively, is more convenient and useful to the pharmacist. The graduations upon the stem are not arbitrarily chosen, but indicate at once the specific gravity of a liquid when floated in it. Two hydrometers are necessary, one for liquids heavier than water, and one for liquids lighter than water; for special purposes it is often desirable to have five or six hydrometers, beginning with one for very light liquids and ending with one for very heavy liquids; and if the diameter of the stem is narrow the divisions in the scale are not so close together, and thus a more accurate reading of the graduations is possible and the delicacy of the hydrometer increased. It must be borne in mind, however, that the hydrometer cannot be as accurate an instrument for taking specific gravity as the specific gravity bottle. The adhesion of air bubbles when in use, the liability to variation in the diameter of the stem, the inaccuracies in the scale and the difficulties of adjusting it so as to give correct readings, and the want of uniformity among the makers in fixing the reading point, render it necessary for the pharmacist to verify each instrument and note its error before accepting it for practical use. In selecting an hydrometer with a specific gravity scale, it should be at once noticed whether the graduated spaces are equal. If they are, it is useless to attempt to

verify it, as it cannot be accurate, for the degree of the immersion varies with the specific gravity of the liquid, and "equal differences of specific gravity cannot be indicated by equal spaces on the scale, but by the differences of the reciprocals of those specific gravities, or by proportionate quantities." In the illustration shown in Fig. 52, the arbitrary scale of Baumé, made up of equal spaces, is shown immediately in contact with a specific gravity scale. The spaces of the latter gradually increase in size from below upward, and the highest space is nearly four times the size of the lowest. The method of graduating this scale differs with different makers, but by the use of Clarke and Ackland's process it is possible to make a scale without using any other liquid than water if a correct table of reciprocals is employed (see Watts's Dictionary, vol. iii. p. 207). Before any hydrometer is accepted for use, it should be tested by floating it in water at the temperature indicated on the hydrometer, and, the specific gravity of several liquids having been ascertained carefully by the specific gravity bottle, the hydrometer should be floated in the same liquids, and any deviation carefully noted. An hydrometer which registers uniformly one or two points too low or too high need not be rejected, because the error can be added or subtracted each time and the constant error marked on the box for a memorandum; but if an error of any magnitude has to be added to one part of the scale, and another subtracted from another part, it is economy to reject the instrument at once. Hydrometers are usually floated in tall, cylindrical glass jars (see Fig. 54), and it is frequently necessary to cool the liquid by placing the jar in ice water after inserting a thermometer, and, after the temperature has been lowered to the desired degree, observing the point to which the hydrometer sinks in the liquid. It is to be regretted that there is no fixed rule for a reading point; some makers adjust their instruments so as to read from a reflection in the upper part of the meniscus, others (probably the majority) prefer to take the exact level of the liquid, disregarding the meniscus altogether; this may be easily done in all cases where the liquid is transparent, or nearly so, by holding the jar containing the hydrometer at first exactly on a level with the eye, and then glancing slightly below, when a line can be traced which will exactly join the divided surface of the liquid upon either side of the stem. In case of opaque liquids an allowance can be made for the meniscus. The pharmacist should choose one or the other method and adhere to his choice, so that his verification of his own hydrometer may not vary (see Fig. 55, in which the arrow shows the point to read). It is usually best to cool the liquid below the standard temperature adopted for the hydrometer, and then, after wiping the jar, the correct higher temperature may be gradually obtained by grasping the jar with the hands and passing them up and down to warm the liquid. An hydrometer having an elongated bulb with cylindrical sides, as shown in Fig. 56, is more likely to give a false indication if permitted to touch the sides of the

Fig. 54

Hydrometer jar

Fig. 55

Urinometer and jar (Squibb)

jar than one having an oval or globular bulb (see Fig. 55); the latter can touch the jar at only one point, and hence can move freely up and down, while the former may have one side touching the side of the jar for its entire length. To obviate this, Dr. Squibb suggests the use of a jar with four perpendicular indentations in it, and an hydrometer having an oval bulb (see Fig. 55). The points of contact between the urinometer bulb and the indentations in the jar are best shown in the transverse sectional view immediately below the cut of the urinometer.

FIG. 56

Alcoholmeter

The *urinometer* is one of the most useful special applications of the hydrometer; as its name indicates, it is used to take the specific gravity of urine; a special scale, which is easily understood, is sometimes used. The very delicate stem, which hardly permits of the use of specific gravity figures, is divided into sixty spaces, numbered from 0 to 60; by adding 1000 to each of these numbers, and pointing off three decimal places from the right, the true specific gravity is shown. In Dr. Squibb's urinometer the specific gravity is indicated without abbreviation, the number highest on the scale being 1.000, the lowest 1.060, the intervening figures being 1.010, 1.020, 1.030, 1.040, and 1.050.

The specific gravity of urine from healthy subjects ranges from 1.010 to 1.020; that from diabetic patients has a specific gravity varying from 1.030 to 1.060.

The *saccharometer* is intended to take the specific gravity of syrups. The scale is sometimes graduated so as to indicate the percentage of sugar in solution, rarely the actual specific gravity; usually Baumé's scale (*pèse-sirop*) is used. The *elæometer*, a very delicate instrument, is used to take the specific gravity of fixed oil. The *lactometer* is employed in detecting the adulteration of milk with water; it has a limited range, and the scale usually shows the points at which it floats in milk mixed with different proportions of water. Hydrometers are often made for taking the specific gravity of liquids, like petroleum benzin, ether, petroleum, vinegar, wine, beer, solutions of silver nitrate, sea water, etc.; probably the most useful to the pharmacist of all those having special applications is the one made for testing alcohol.

Alcoholmeters may be purchased which combine the thermometer with the hydrometer, as shown in Fig. 56, and the scale frequently has the percentage by volume of absolute alcohol marked opposite the corresponding specific gravity; when graduated so as to show the percentage by weight, they were formerly more useful, on account of the adoption of the principle of parts by weight in the U. S. Pharmacopœia of 1880, thus obviating the necessity of using an alcoholmetrical table or making a calculation.

Tralles's hydrometer is an alcoholmeter having a centesimal scale. It is used by the United States government in gauging spirits, and is in general use by distillers and others. Each division of the scale corresponds to a given percentage of pure alcohol by volume in the liquor. In the United States Dispensatory, 19th

edition, page 1752, a table is given showing the value of Tralles's degrees in specific gravity and Baumé's degrees.

Cartier's hydrometer, largely used in France, is merely a modification of Baumé's *pèse-esprit*, or hydrometer for liquids lighter than water; the zero of the scale is the same as Baumé's (10°), but the degrees are not of the same value, 32° of Baumé's scale being equal to 30° Cartier. Dorvault gives the following approximate rule for conversion: Cartier's degrees may be converted into Baumé's by subtracting 10, multiplying the remainder by 0.08, and adding the product to Cartier's degree.

Baumé's degrees may be converted into Cartier's by subtracting 10, multiplying the remainder by 0.08, and subtracting the product from Baumé's degree.

Gay-Lussac's centesimal alcoholmeter has a scale divided into 100 unequal degrees. The zero corresponds to pure water at 15° C. (59° F.) and the 100 mark to absolute alcohol. The advantage of this method is that every intermediate degree expresses the percentage of pure alcohol by measure contained in the spirit. Thus, when the instrument stands at the 50 mark in an alcoholic liquid, it indicates that 100 measures of the liquid contain 50 of pure alcohol.

Sikes's hydrometer is used in Great Britain in the collection of the excise revenue. It is a brass instrument having a spherical bulb, with a weight at the bottom to make it float upright; the stem is divided into 20 parts, and every other division numbered, from 0 to 10. A series of nine weights are furnished with the instrument, numbered from 10 to 90; these are to be added to the weight at the bottom to cause the hydrometer to sink, so that a reading may be had on the graduated scale; this reading added to the number on the weight employed, gives a figure which indicates the strength of the spirit by referring to a table which accompanies the instrument.

Jones's hydrometer is similar to Sikes's, but by many is regarded as an improvement on it.

Dica's hydrometer belongs to the same class.

Twaddell's hydrometer is frequently employed in England, and technical works often quote the degrees of this scale. It is used for liquids heavier than water, and is graduated so that the number of the degree, multiplied by 5 and added to 1000, gives the specific gravity. Thus, 20° Twaddell indicates the specific gravity of 1100 or 1.100; 50° Twaddell, 1250 or 1.250.

Beck's hydrometer is rarely used or referred to. In this scale 0 corresponds to the specific gravity 1.00, and 30 to that of 0.850; the scale is extended equally above and below 0. For tables, see Bayley's Chemist's Pocket Book, p. 178.

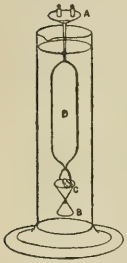
Zanetti's hydrometers have a scale which requires the addition of a cipher to the number of the degree to show the specific gravity.

2. Hydrometers in which the depth of the immersion is constant, but the weight subject to change.

Fahrenheit's hydrometer was one of the first instruments of this class to come into general use. Robert Boyle described, however, in 1675, his "New Essay Instrument," and Fahrenheit's hydrometer was very similar to it in principle; it had but a single mark on the stem, which was surmounted by a small scale pan; weights were placed in

the pan to cause the hydrometer to sink to the mark. Now, as this mark indicated the point at which the instrument would float in water at a given temperature when certain weights were placed on the pan, it follows that when it was immersed in a liquid of different specific gravity the weights would have to be changed to float the instrument to the fixed mark; the ratio which this weight bore to the weight used for water gave the specific gravity.

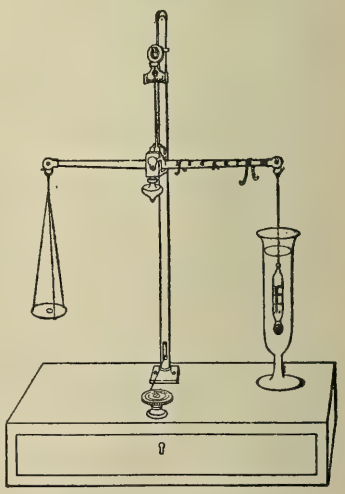
FIG. 57



Nicholson's hydrometer

Nicholson's hydrometer is similar in principle to Fahrenheit's, but is modified so that it can be used for taking the specific gravity of heavy or light solids. Fig. 57 is an illustration of one of the most convenient forms of the instrument; it is usually made of brass; there is a single mark on the stem and a scale pan on the summit. To the lower extremity of the hydrometer two conical cups are attached; their apexes are joined so as to resemble an hour glass; the lowest cone has several apertures at the top, to permit of the escape of air when the instrument is immersed. The weight of the hydrometer is usually so adjusted that a 1000 grain weight is needed on the scale pan to float it to the mark on the stem. Now, to take the specific gravity of a piece of zinc weighing less than 1000 grains, the 1000 grain weight is removed from the pan and the piece of zinc substituted for it, weights are added until the instrument floats at the mark on the stem, and it is found that an addition of 655 grains has been necessary. It is evident that the difference between 1000 and 655 gives the weight in air of the zinc, 345 grains. The zinc is now placed in the upper conical cup and weights are again placed upon the scale pan, and it is found that the zinc has lost in weight 50 grains by immersion in water; the specific gravity is obtained by applying the well known rule,—divide the weight of the body by the loss of weight in water: $\frac{345}{50} = 6.9$, sp. gr. of zinc. The lower cup is used for taking the specific gravity of bodies lighter than water, and is very convenient, the weight of the hydrometer keeping the light body submerged when the lower cup is placed over it. The specific gravity is obtained in the same manner as in the case of bodies heavier than water. One of the advantages of Nicholson's hydrometer is that it can be used in place of a balance for weighing small quantities, as shown above.

FIG. 58



Mohr's specific gravity apparatus

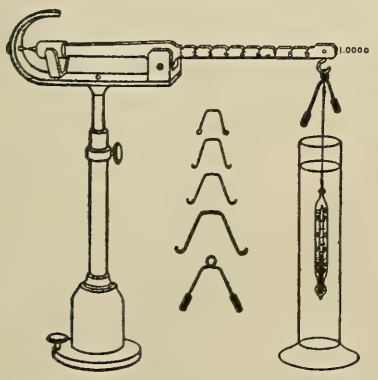
Methods of taking the Specific Gravity of Small Quantities of Liquids.

Mohr's Apparatus.—The illustration of this apparatus (see Fig. 58) represents an improved form, yet it is quite possible for a phar-

macist to construct one for himself that will answer practical purposes. It will be noticed that one end of the beam is divided into ten equal spaces, and a small glass thermometer is suspended from the extremity by a slender platinum wire, while the opposite scale pan is so adjusted that it exactly counterbalances the thermometer. When the thermometer is immersed in pure water at 25° C. (77° F.), a brass wire weight is placed upon the hook at the end of the beam, and this restores the equilibrium. Now, it is apparent that if a lighter liquid, like alcohol at 25° C. (77° F.), is substituted for the water, the equilibrium cannot be maintained, and the thermometer will sink. The brass wire weight is then to be moved along the beam toward the central knife edge until the balance is nearly restored, and this point will be found at 8, which gives the first decimal figure; still further to approach the equilibrium, a wire weight, one-tenth the weight of the larger one, is pushed along the beam until it rests at the 2 mark, which gives the second decimal figure; while thoroughly to restore the balance the smallest weight (one-tenth of the second) is placed at 5, and thus the third decimal figure is obtained, and the specific gravity of the alcohol is shown to be 0.825. Specific gravities of liquids heavier than water are obtained in the same way, except that the large brass wire weight is left hanging on the hook at the end of the beam and additional weights are placed upon the beam until equilibrium is restored.

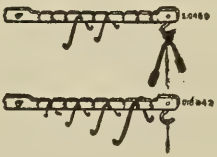
A prescription balance could be easily converted into a Mohr's apparatus, and the thermometer replaced by a glass stopper suspended by a horsehair. The thermometer in the improved form of apparatus merely serves to indicate the temperature and act as a convenient weight. In the home made apparatus especial care must be exercised in adjusting the wire hook weight so as exactly to immerse the stopper in water at the proper temperature.

FIG. 59



Westphal specific gravity balance

Westphal Specific Gravity Balance.—This balance is more convenient than the Mohr's apparatus because a sliding weight (see Fig. 59) is used on the beam at the left, instead of ordinary weights in the pan. The riders have different weights, as is the case in Mohr's apparatus.

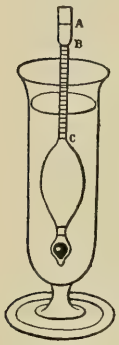


Gannal's Method.—Gannal suggested a very convenient modification of this method of taking the specific gravity of a liquid. A piece of glass, "densimetre hydrostatique," having the shape of an olive,

has a volume of 10 cubic centimeters. This is suspended from the hook at the end of the beam of a balance by a horsehair (see Fig. 43), and weights are added to the opposite scale pan until the balance is restored; it is then immersed in the liquid, and the metric weight required to restore the equilibrium gives the specific gravity without a calculation.

Specific Gravity Pipette.—Grauer recommends the use of a small pipette having a fine orifice at the lower end, and at the upper end a short piece of rubber tube closed by a pinchcock; a mark is scratched on the pipette to show a point to which a convenient weight of water rises (1 Gm.); enough of the liquid to be tested is drawn by the mouth through the tube to rise to the mark, and it is then closed; the weight of the liquid indicates its specific gravity.

Fig. 60



Rousseau's densimeter

Rousseau's Densimeter.—This ingenious instrument is constructed upon the plan of an hydrometer (see Fig. 60). The stem from B to C is divided into 20 equal parts; the cup-shaped tube upon the summit of the stem holds exactly 1 cubic centimeter. When the densimeter is floated in water at the proper temperature, it sinks to the point C at the bottom of the stem; when the cup is filled with water to the cubic centimeter mark, it causes the instrument to sink to the point B; this space, B C, being divided into 20 equal parts, it follows that each division corresponds to $\frac{1}{20}$ of a gramme, or 0.05 Gm. If one Cc. of oil of rose were placed in the cup, it would sink the densimeter to 17.2 divisions of the scale; then $17.2 \times 0.05 = 0.860$, the specific gravity of oil of rose.

Table giving the Specific Gravities of Pharmacopœial Substances arranged in the Order of their Densities at 25° C. (77° F.)

Official Name	Specific Gravity	Weight of one Fluidounce in grains
Benzinum Purificatum	0.638–0.660	290.0–300.0
Æther	0.713–0.716	324.1–325.5
Collodium	0.765–0.775	347.8–352.3
Acetonum	about 0.790	359.1
Alcohol Dehydratum, 15.6° C. (60° F.)	0.798	362.8
Spiritus Glycerylis Nitratis	0.814–0.820	370.0–372.7
Alcohol, 15.6° C. (60° F.)	0.816	370.9
Petrolatum, 60° C. (140° F.)	0.820–0.865	
Spiritus Ætheris Nitrosi	0.823	374.1
Petrolatum Liquidum	0.828–0.905	376.4–411.4
Oleum Aurantii	0.842–0.846	382.7–384.6
Limonis	0.851–0.855	386.8–388.7
Pini Pumilionis	0.853–0.869	387.7–395.0
Juniperi	0.854–0.879	388.2–399.5
Terebinthinæ Rectificatum	0.856–0.865	389.1–393.2
Myristicæ	0.859–0.924	390.5–420.0
Terebenum	0.860–0.865	390.9–393.2
Oleum Terebinthinæ	0.860–0.870	390.9–395.5
Coriandri	0.863–0.875	392.3–397.7
Amylis Nitris	0.865–0.875	393.2–397.7
Oleum Lavandulæ	0.875–0.888	397.8–403.6
Rosmarini	0.894–0.912	406.4–414.6

Table giving the Specific Gravities of Pharmacopœial Substances arranged in the Order of their Densities at 25° C. (77° F.)—*Continued.*

Official Name	Specific Gravity	Weight of one Fluidounce in grains
Oleum Thymi	0.894–0.930	406.4–422.7
Acidum Oleicum	0.895	406.8
Oleum Menthæ Piperitæ	0.896–0.908	407.3–412.7
Aqua Ammoniæ Fortior	0.897	407.7
Paraffinum	0.900	
Spiritus Ammoniæ Aromaticus	0.900	409.1
Oleum Cari	0.900–0.910	409.1–413.7
Eucalypti	0.905–0.925	411.4–420.5
Cubebæ	0.905–0.925	411.4–420.5
Amygdalæ Expressum	0.910–0.915	413.7–415.9
Olivæ	0.910–0.915	413.7–415.9
Cajuputi	0.912–0.925	414.5–420.5
Gossypii Seminis	0.915–0.921	415.9–418.7
Sesami	0.916–0.921	416.4–418.7
Menthæ Viridis	0.917–0.934	416.8–424.5
Morrhuæ	0.918–0.922	417.3–419.1
Æthylis Chloridum, 0° C. (32° F.)	0.921	418.7
Eucalyptol	0.921–0.923	418.7–419.6
Oleum Lini	0.925–0.935	420.5–425.0
Acidum Sulphuricum Aromaticum	0.933	424.1
Alcohol Dilutum, 15.6° C. (60° F.)	0.935–0.937	425.0–425.9
Oleum Tiglii	0.935–0.950	425.0–431.8
Cetaceum	0.938–0.944	
Copaiba	0.940–0.995	427.3–452.3
Oleum Ricini	0.945–0.965	429.6–438.7
Cera Alba	0.950–0.960	
Flava	0.950–0.960	
Oleum Fœniculi	0.953–0.973	433.2–442.3
Chenopodii	0.955–0.980	434.1–445.5
Aqua Ammoniæ	0.958	435.5
Oleum Picis Liquidæ Rectificatum	0.960–0.990	436.4–450.0
Santali	0.965–0.980	438.7–445.5
Theobromatis	0.973	
Anisi	0.978–0.988	444.5–449.1
Cadinum	0.980–1.055	445.5–479.6
Camphora	0.990	
Paraldehydum	0.990	450.0
Aqua Destillata	**1.000**	**454.6**
Tinctura Ferri Chloridi	1.00	454.6
Acidum Aceticum Dilutum	1.008	458.2
Oleum Sinapis Volatile	1.013–1.020	460.5–463.7
Fel Bovis	1.015–1.025	
Oleum Pimentæ	1.018–1.048	462.7–476.4
Cresol	1.030–1.038	468.2–471.8
Oleum Amygdalæ Amaræ	1.038–1.060	471.8–481.8
Oleum Caryophylli	1.038–1.060	471.9–481.8
Liquor Ferri et Ammonii Acetatis	1.039	472.3
Acidum Hypophosphorosum Dilutum	1.042	473.7

Table giving the Specific Gravities of Pharmacopœial Substances arranged in the Order of their Densities at 25° C. (77° F.)—*Continued.*

Official Name	Specific Gravity	Weight of one Fluidounce in grains
Acidum Aceticum	1.045	475.0
Benzaldehydum	1.045	475.0
Oleum Cassiæ	1.045–1.063	475.0–483.2
Liquor Potassii Hydroxidi	1.046	475.5
Acidum Aceticum Glaciale	1.047–1.050	475.9–477.3
Hydrochloricum Dilutum	1.049	476.8
Liquor Sodii Hydroxidi	1.056	480.0
Acidum Phosphoricum Dilutum	1.057	480.5
Eugenol	1.064–1.070	483.6–486.4
Phenol Liquefactum	1.065	484.1
Oleum Sassafras	1.065–1.077	484.1–489.6
Acidum Sulphuricum Dilutum	1.067	485.0
Creosotum	1.073	487.8
Acidum Hydrobromicum Dilutum	1.076	489.1
Mel (diluted with 2 parts of water)	1.099	499.6
Acidum Hydriodicum Dilutum	1.100	500.0
Guaiacol	1.110–1.114	504.6–506.4
Acidum Hypophosphorosum	1.130	513.7
Balsamum Peruvianum	1.130–1.160	513.7–527.3
Creosoti Carbonas	1.145–1.170	520.5–531.8
Acidum Hydrochloricum	1.155	525.1
Methylis Salicylas (natural)	1.172–1.182	532.8–537.3
Methylis Salicylas (synthetic)	1.180–1.185	536.4–538.7
Acidum Lacticum	1.206	548.2
Syrupus Acidi Hydriodici	1.215	552.3
Liquor Plumbi Subacetatis	1.245	565.9
Glycerinum	1.249	567.8
Liquor Ferri Chloridi	1.29–1.32	586.4–600.1
Syrupus	1.313	596.8
Ferri Iodidi	1.35	613.7
Mel	1.370	622.8
Acidum Nitricum	1.403	637.8
Liquor Ferri Tersulphatis	1.432	650.9
Chloroformum	1.474–1.478	670.0–671.9
Liquor Zinci Chloridi	1.548	703.7
Ferri Subsulphatis	1.548	703.7
Acidum Phosphoricum	1.72	781.9
Phosphorus	1.830	
Acidum Sulphuricum	1.83	831.9
Bromoformum	2.595–2.620	1179.6–1191.0
Iodum, 17° C. (62.6° F.)	4.66	
Hydrargyrum	13.5	6137.1

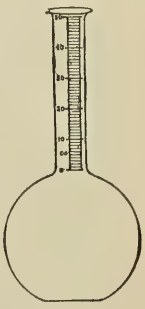
Specific Volume

Specific volume in pharmacy may be defined *as the volume of one body compared with the volume of an equal weight of another body selected as the standard, both bodies having the same temperature.* It is directly the opposite of specific gravity. The temperature chosen is usually 25° C. (77° F.). 1. *To obtain the specific volume of a liquid.*—**Rule,**

Divide the volume of the given weight of the liquid by the volume of an equal weight of water, or divide the specific gravity of water (1.000) by the specific gravity of the liquid. Ex. 1403 Gm. of nitric acid measure 1000 mils and 1403 Gm. of water measure 1403 mils; then $\frac{1000}{1403} = 0.7127$, sp. vol. of nitric acid. 2. *To obtain the volume of a given weight of a liquid.*—**Rule,** Multiply the volume of an equal weight of water by the specific volume of the liquid. Ex. How many fl. oz. are there in 100 oz. av. of nitric acid? 100 oz. av. of water measure 96.21 fl. oz.; then $96.21 \times 0.7127 = 68.56+$ fl. oz. of nitric acid.

Very early in the tyro's experience the fact is recognized that pound bottles designed for different liquids vary in size, a pint bottle, for instance, of water (which may be regarded as a rough standard) holding about a pound avoirdupois; the same bottle, however, would only be four-fifths full if a pound of glycerin were poured into it, and two-thirds full if chloroform were used, while a pound of petroleum benzin would fill the pint bottle, and there would be almost enough to spare to fill another pint bottle. A bottle which would hold a pound of ether would hold two pounds of chloroform, and a pint bottle holding one pound of water holds fourteen pounds of mercury. These facts are, of course, capable of the explanation that the specific volumes of liquids lighter than water are greater than that of water, while those of liquids heavier than water are less. An instructive and useful bottle may be made by selecting a flask with a long and not very narrow neck (see Fig. 61), the bulb of which would hold about 100 mils of water at 4° C.; if the neck would hold about 50 mils of the same liquid at the same temperature, and a mark was made at the 100 mil point and the tube graduated from 100 mils to 150 mils, it would follow that in order to find the specific volume of any lighter liquid within the capacity of the bottle, all that would be necessary would be to pour into the flask 100 Gm. of such liquid at the proper temperature and read off the point to which the liquid rises. A bottle to be used for heavy liquids would have the 100 mil mark at the top of the neck and the mil graduations below decrease in value. A bottle of limited range may be constructed having the 100 mil mark half way between the top of the bulb and the top of the neck. That specific volume is the antithesis of specific gravity is shown by the fact that in order to obtain the specific volume of a liquid the measure of a given weight of the liquid is divided by the measure of an equal weight of water, and (as has been shown heretofore) specific gravity is obtained by dividing the weight of a given measure of the liquid by the weight of an equal measure of water; therefore it follows that when the specific volume of a liquid is multiplied by its specific gravity the product must be 1, or the specific gravity of water.

FIG. 61



Specific volume bottle

Weight and Volume Relations, U. S. P. IX

Specific gravity true $\frac{25°\ C.}{25°\ C.}$	Specific volume.	Weight of 1 U. S. gallon in pounds avoirdupois in air.	Weight of 100 fluid-ounces in ounces avoirdupois.	Weight of 1 fluidounce in grains.	Volume in U. S. gallons of 100 lbs. avoirdupois.	Volume in fluidounces of 100 ozs. avoirdupois.	Volume in fluidounces of 1000 grains.
0.70	1.4286	5.816	72.70	318.0	17.195	137.56	3.144
0.71	1.4085	5.899	73.74	322.6	16.953	135.62	3.100
0.72	1.3889	5.982	74.78	327.1	16.717	133.73	3.057
0.73	1.3699	6.065	75.82	331.7	16.487	131.90	3.015
0.74	1.3514	6.149	76.86	336.2	16.264	130.11	2.974
0.75	1.3333	6.232	77.90	340.8	16.047	128.38	2.934
0.76	1.3158	6.315	78.94	345.3	15.836	126.69	2.896
0.77	1.2987	6.398	79.98	349.9	15.630	125.04	2.858
0.78	1.2821	6.481	81.02	354.5	15.429	123.43	2.821
0.79	1.2658	6.565	82.06	359.0	15.233	121.87	2.786
0.80	1.2500	6.648	83.10	363.6	15.043	120.34	2.751
0.81	1.2346	6.731	84.14	368.1	14.857	118.85	2.717
0.82	1.2195	6.814	85.18	372.7	14.675	117.40	2.684
0.83	1.2048	6.897	86.22	377.2	14.496	115.99	2.651
0.84	1.1905	6.981	87.26	381.8	14.325	114.60	2.620
0.85	1.1765	7.064	88.30	386.3	14.157	113.25	2.589
0.86	1.1628	7.147	89.34	390.9	13.992	111.93	2.559
0.87	1.1494	7.230	90.38	395.4	13.831	110.65	2.529
0.88	1.1364	7.314	91.42	400.0	13.673	109.39	2.500
0.89	1.1236	7.397	92.46	404.5	13.520	108.16	2.472
0.90	1.1111	7.480	93.50	409.1	13.369	106.95	2.445
0.91	1.0989	7.563	94.54	413.6	13.222	105.78	2.418
0.92	1.0870	7.646	95.58	418.2	13.078	104.62	2.391
0.93	1.0753	7.730	96.62	422.7	12.937	103.50	2.366
0.94	1.0638	7.813	97.66	427.3	12.799	102.40	2.341
0.95	1.0526	7.896	98.70	431.8	12.666	101.32	2.316
0.96	1.0417	7.979	99.74	436.4	12.532	100.26	2.292
0.97	1.0309	8.063	100.78	440.9	12.403	99.23	2.268
0.98	1.0204	8.146	101.82	445.5	12.276	98.21	2.245
0.99	1.0101	8.229	102.86	450.0	12.152	97.22	2.222
1.00	1.0000	8.312	103.90	454.6	12.031	96.24	2.200
1.02	0.9804	8.479	105.98	463.7	11.794	94.36	2.157
1.04	0.9615	8.645	108.06	472.8	11.567	92.54	2.115
1.06	0.9434	8.812	110.14	481.9	11.349	90.79	2.075
1.08	0.9259	8.978	112.22	491.0	11.138	89.11	2.037
1.10	0.9091	9.144	114.31	500.1	10.936	87.49	2.000
1.12	0.8929	9.311	116.39	509.2	10.740	85.92	1.964
1.14	0.8772	9.477	118.47	518.3	10.552	84.41	1.929
1.16	0.8621	9.644	120.55	527.4	10.370	82.96	1.896
1.18	0.8475	9.810	122.63	536.5	10.194	81.55	1.864
1.20	0.8333	9.977	124.71	545.6	10.024	80.19	1.833
1.22	0.8197	10.143	126.79	554.7	9.859	78.87	1.803
1.24	0.8065	10.309	128.87	563.8	9.700	77.60	1.774
1.26	0.7937	10.476	130.95	572.9	9.546	76.37	1.746
1.28	0.7813	10.642	133.03	582.0	9.396	75.17	1.718

Weight and Volume Relations, U. S. P. IX—*Continued.*

Specific gravity true 25° C. / 25° C.	Specific volume.	Weight of 1 U.S gallon in pounds avoirdupois in air.	Weight of 100 fluid-ounces in ounces avoirdupois.	Weight of 1 fluidounce in grains.	Volume in U. S. gallons of 100 lbs. avoirdupois.	Volume in fluidounces of 100 ozs. avoirdupois.	Volume in fluidounces of 1000 grains.
1.30	0.7692	10.809	135.11	591.1	9.252	74.01	1.692
1.32	0.7576	10.975	137.19	600.2	9.111	72.89	1.666
1.34	0.7463	11.142	139.27	609.3	8.975	71.80	1.641
1.36	0.7353	11.308	141.35	618.4	8.843	70.75	1.617
1.38	0.7246	11.475	143.43	627.5	8.715	69.72	1.594
1.40	0.7143	11.641	145.51	636.6	8.590	68.72	1.571
1.42	0.7042	11.807	147.59	645.7	8.469	67.75	1.549
1.44	0.6944	11.974	149.67	654.8	8.352	66.81	1.527
1.46	0.6849	12.140	151.75	663.9	8.237	65.90	1.506
1.48	0.6757	12.307	153.83	673.0	8.126	65.01	1.486
1.50	0.6667	12.473	155.92	682.1	8.017	64.13	1.466
1.52	0.6579	12.640	158.00	691.2	7.912	63.29	1.447
1.54	0.6494	12.806	160.08	700.3	7.809	62.47	1.428
1.56	0.6410	12.973	162.16	709.4	7.709	61.67	1.410
1.58	0.6329	13.139	164.24	718.5	7.611	60.89	1.392
1.60	0.6250	13.305	166.32	727.6	7.516	60.13	1.374
1.62	0.6173	13.472	168.40	736.7	7.423	59.38	1.357
1.64	0.6098	13.638	170.48	745.8	7.332	58.66	1.341
1.66	0.6024	13.805	172.56	754.9	7.244	57.95	1.325
1.68	0.5952	13.971	174.64	764.1	7.158	57.26	1.309
1.70	0.5882	14.138	176.72	773.2	7.073	56.59	1.293
1.72	0.5814	14.304	178.80	762.3	6.991	55.93	1.278
1.74	0.5747	14.470	180.88	791.4	6.911	55.29	1.264
1.76	0.5682	14.637	182.96	800.5	6.832	54.66	1.249
1.78	0.5618	14.803	185.04	809.6	6.755	54.04	1.235
1.80	0.5556	14.970	187.12	818.7	6.680	53.44	1.222
1.82	0.5495	15.136	189.20	827.8	6.607	52.85	1.208
1.84	0.5435	15.302	191.28	836.9	6.535	52.28	1.195
1.86	0.5376	15.469	193.36	846.0	6.465	51.72	1.182
1.88	0.5319	15.636	195.44	855.1	6.396	51.17	1.170
1.90	0.5263	15.802	197.53	864.2	6.328	50.63	1.157
1.92	0.5208	15.968	199.61	873.3	6.262	50.10	1.145
1.94	0.5155	16.135	201.69	882.4	6.198	49.58	1.133
1.96	0.5102	16.301	203.77	891.5	6.135	49.08	1.122
1.98	0.5051	16.468	205.85	900.6	6.073	48.58	1.110
2.00	0.5000	16.634	207.93	909.7	6.012	48.09	1.100

PRACTICAL PROBLEMS AND EXERCISES

Illustrating the Uses of Weights, Measures, Specific Gravity, and Specific Volume

(The answers to these questions will be found on page 108)

1. If Dover's powder contains one grain of powdered ipecac, one grain of powdered opium, and eight grains of powdered sugar of milk, how much of each ingredient will be needed to make one pound (av.)?

2. What is the percentage of each ingredient in Dover's powder?
3. Add the following together, giving the answer in grains: ℥ iv, ℈ ii, ʒ vi, 2 oz.
4. Subtract ʒ x from 10 oz.
5. How much postage would be required to send a book, weighing 4 lb. 3 oz., to Brazil, the rate being one cent for each 2 oz. or fraction?
6. How many fluidounces are there in a wine gallon?
7. How many minims are there in a pint?
8. In an Imperial pint?
9. How many grains are there in 4 oz. av. of water? 10. In f ℥ iv? 11. In ʒ iv?
12. How many wine gallons are there in 40 Imperial gallons?
13. How many avoirdupois pounds in 5 wine gallons of water?
14. How many fluidrachms in an Imperial half-pint of water?
15. A physician ordered, as an application to a burn, 4 tablespoonfuls of linseed oil to be mixed with a teacupful of lime water. What are the equivalent quantities in apothecaries measure?
16. A traveller was ordered by his physician to take with him on a journey enough of a quinine mixture to last five weeks, taking one teaspoonful three times a day for the first week, one twice a day for the second week, one once a day for the third week, one four times during the fourth week, and one twice during the fifth week. How many fluidounces of the mixture must the apothecary compound for him?
17. A physician wants a pharmacist to make him one fluidounce of a one per cent. aqueous solution of cocaine hydrochloride. How will he do it?
18. How much quinine, strychnine, and ferric phosphate would be required to make a pint of elixir of iron, quinine, and strychnine phosphates, so that each teaspoonful of finished elixir should contain $\frac{1}{64}$ of a grain of strychnine, one grain of quinine, and two grains of ferric phosphate?
19. What would an Imperial gallon of rose water cost at the rate of 12 cents a pound (av.)?
20. A merchant offered to exchange 2 oz. of musk, valued at 4 cents per grain, for 20 Imperial gallons of orange flower water, valued at 17 cents per pound. How much would he gain or lose?
21. Express the following : 7.5 meters in millimeters. 22. 806.23 centimeters in meters. 23. Six meters and three decimeters. 24. Twelve meters, five decimeters, four centimeters, and three millimeters. 25. Twelve thousand five hundred and forty-three millimeters.
26. Write one meter and one millimeter. 27. Read 25 Dm. 28. Read 25 dm.
29. Is the equivalent number of centimeters usually read in practice instead of using the term decimeters?
30. Read 1.2 M.
31. How does this practice resemble that in daily use in relation to our decimal system of coinage? (See No. 30.)
32. Read 4263.678 M.
33. Add 816 cm., 732 dm., and 36 mm.
34. What is the difference in length between two roots, one being 5 cm. long, and the other 65 mm. long?
35. Divide 3784.128 M. by 8.
36. How many square millimeters are there in 5 square centimeters?

NOTE.—In square measure length is multiplied by width ($10 \times 10 = 100$), hence each denomination is increased or decreased by 100 instead of by 10; two decimal places are therefore required to express square measure.

37. Write eight sq. meters, thirty-six sq. decimeters.
38. Write eight sq. meters, thirty-six sq. decimeters, eight sq. centimeters.
39. Write three sq. M., three sq. dm., three sq. cm., three sq. mm.
40. Express in figures twenty sq. millimeters, twenty sq. centimeters, twenty sq. decimeters, twenty sq. meters.
41. Express in figures five hundred sq. meters, five hundred sq. decimeters, five hundred sq. millimeters.
42. How many mils in a cubic meter?

NOTE.—In cubic measure length is multiplied by width and this by thickness, $10 \times 10 \times 10 = 1000$; so that three decimal places are required to express cubic measure.

43. Express in figures sixty-three cubic meters, sixty-three cubic decimeters, sixty-three cubic centimeters, sixty-three cubic millimeters.
44. How many mils in a liter?
45. What metric measure of capacity corresponds with a cubic decimeter?
46. How many 100-mil bottles will be required to hold five liters of water?
47. A drug merchant having purchased a cubic meter of olive oil, sold from it at different times 100 liters, 87 liters, 375 mils, 638 liters. How much had he left?
48. In making one kilo of U. S. 1880 compound spirit of juniper, how many grammes of each ingredient would be required, the formula being as follows: Oil of juniper 10 parts, oil of caraway 1 part, oil of fennel 1 part, alcohol 3000 parts, water 1988 parts?
49. How many grains of each ingredient would be required to make one pound avoir.? (See No. 48.)
50. What percentage of an avoirdupois pound is a troy pound?
51. How much water must be added to a pint of solution of ferric chloride (containing 37.8 per cent. of anhydrous salt, specific gravity 1.387) to make the solution contain 10 per cent. of anhydrous salt?
52. How much of the above solution of ferric chloride and how much water must be used to make a pint of solution containing 20 per cent.? (See No. 51.)
53. If moist opium containing $10\frac{1}{2}$ per cent. morphine loses 30 per cent. of its weight by drying, how much morphine per cent. will it contain when dry?
54. If one pint of a solution contain 704 grains, how much is there in each fluidrachm?
55. If one fluidrachm of a solution contain $3\frac{1}{4}$ grains, how much is there in $14\frac{1}{2}$ fluidounces?
56. If 8 fluidounces contain 240 doses, how much in each dose?
57. How many doses of $12\frac{1}{2}$ minims in $12\frac{1}{2}$ fluidounces?
58. If 96 minims of water will dissolve $7\frac{7}{8}$ grains of salt, how much will one pint dissolve?
59. How much will one pound avoirdupois dissolve? (See No. 58.)
60. How much will one pound troy dissolve? (See No. 58.)
61. If Liquor Acidi Arsenosi contains 37 grains of arsenic trioxide in 8 fluidounces, what fraction of a grain (exactly) is there in a fluidrachm?
62. If Liquor Ferri Citratis (U. S. P. 1890) (specific gravity 1.250) contains 35.5 per cent. of anhydrous salt, how much of the anhydrous salt is contained in 1 pint?
63. How much in one fluidrachm? (See No. 62.)
64. If Liquor Ferri Nitratis (U. S. P. 1890) contains 6 per cent. of anhydrous salt (specific gravity 1.050), how much of the salt is there in each fluidounce?
65. If Liquor Ferri Subsulphatis (specific gravity 1.548) contains 43.7 per cent. of basic ferric sulphate, how much of the salt is contained in one pound avoirdupois?
66. How much in one pint? (See No. 65.)
67. How much in one fluidrachm? (See No. 65.)
68. How many minims would contain 10 grains? (See No. 65.)
69. Liquor Ferri Tersulphatis (specific gravity 1.432) contains 36 per cent. of normal ferric sulphate. How much in Oi?
70. If Liquor Acidi Arsenosi contains 74 grains of arsenic trioxide in Oi, what quantity of the liquid contains one grain?
71. How many pills of 235 mgm. can be made from a mass weighing 423 grammes?
72. How many cubic inches are there in one liter (1 liter = 2.1134 pints)?
73. What part of a liter is a pint (to four decimal places)?
74. How many mils in a cubic foot (1 mil being equal to 0.061025 cubic inches)?
75. How many mils in a quart (1 L. = 33.815 fl. oz.)?
76. How many pints in one cubic meter (1 deciliter being equal to 3.3815 fluidounces)?
77. How many fluidrachms in a liter?
78. How many grammes in one pound avoirdupois?
79. How many grammes in a quart of a liquid of specific gravity 1.45 (1 gramme = 15.432 grains)?
80. How many milligrammes in one pound troy?
81. How many centimeters in one yard (1 mm. = 0.03937 inch)?
82. What is the weight in grammes of 14 mils of mercury, its specific gravity being 13.5?
83. What is the weight in grammes of 555 mils of sulphuric acid of specific gravity 1.84?
83*a*. What is its weight in kilogrammes? (See No. 83.)

83*b*. What is its weight in milligrammes? (See No. 83.)

84. How many meters are there in a mile (1 meter = 39.37043 inches)?

85. How many inches in 1833 centimeters?

86. How many grains of compound extract of colocynth are required to make 144 compound cathartic pills (there being 62 grs. in 50 pills)?

87. How much jalap is contained in one pound avoirdupois of compound powder of jalap (the official process ordering 35 parts in 100)?

88. What percentage must be added to 400 minims to bring the measure up to one fluidounce?

89. If 32.4 grammes be divided into 144 pills, what is the weight of each pill in grains?

90. If 46.656 grammes be divided into 144 pills, what is the weight of each pill in grammes? What in grains?

91. How much valerian must be used to make 4 pints of tincture, so that eacn fluidrachm shall represent $10\frac{1}{2}$ grains?

92. If a Seidlitz powder is composed of 35 grains of tartaric acid, 40 grains sodium bicarbonate, and 120 grains Rochelle salt, how much Rochelle salt must be used to make enough Seidlitz mixture to put up one gross of boxes of Seidlitz powders, each box to contain ten doses?

93. How much sodium bicarbonate? (See No. 92.)

94. How much tartaric acid? (See No. 92.)

95. How many deciliters of oil (specific gravity 0.905) will a bottle hold which weighs, when full of water, 1050.5 Gm., the weight of the bottle being 610.5 Gm.?

96. If a body weighs 2.31 kilogrammes in air and 1.76 kilogrammes in water, what is its specific gravity?

97. A piece of lead weighs 148.392 pounds, and measures 12 incnes long, 6 inches wide, and 5 inches thick (cu. in. water = 252.+gr.). What is its specific gravity?

98. A piece of zinc weighs in air 77.88 grains, in water 65.88 grains. What is its specific gravity?

99. What is its specific volume? (See No. 98.)

100. What is the weight of a piece of iron measuring 50 cm. long, 6 cm. wide, and 2 cm. thick, its specific gravity being 7.8?

101. What is the length of a bar of iron 8 cm. wide, 5 cm. thick, its specific gravity being 7.8 and its weight 195 kilogrammes?

102. What is the weight of a piece of iron measuring 4 decimeters long by 1 decimeter wide and 7 centimeters thick (specific gravity 7.8)?

103. One pound av. of lead shot is put into a bottle, and it is then filled with water and found to weigh 25566 grains (the bottle when filled with water alone weighs 19174 gr.). What is the specific gravity of the lead shot?

104. What is the specific gravity of a substance of which 9.7 mils equal 40.74 Gm.?

105. What is the specific gravity of a liquid of which one pound avoirdupois will measure one pint?

106. If 52.98 mils of a liquid weigh 1207 grains, what is its specific gravity, and what is the liquid (Oi = 473.18 mils)?

107. If 65.008 mils of a liquid weigh 1250 grains, what is its specific gravity, and what is the liquid?

108. What is the weight in grammes of one pint of glycerin (Oi = 473.18 mils)?

109. What is the weight in grammes of one fluidounce of glycerin?

110. What is the weight of Oi chloroform in grammes (specific gravity 1.476)?

111. What is the weight of one fluidounce of chloroform in grammes?

112. What part of a liter is a pint (to four decimal places)?

113. What part of a gallon is a fluidrachm?

114. What part of a gallon are 32 minims?

115. What part of one pound avoirdupois are $1\frac{1}{2}$ ounces troy?

116. What is the specific gravity of a piece of wood which weighs in air 177.45 grains? A piece of brass weighs 68.25 grains when immersed in water. The wood and brass together immersed in water weigh 35.7 grains.

117. A piece of wood (specific gravity = 1.6), when weighed in oil of turpentine (specific gravity = 0.87), loses 217.5 grains in weight. What is its weight? (Its loss in weight (in oil) divided by the specific gravity of the oil is equal to its loss of weight in water. This multiplied by its specific gravity gives its weight.)

118. A bottle full of water weighs 31 ounces avoirdupois; the same bottle filled with oil (specific gravity 0.91) weighs 29 ounces, 245 grains avoirdupois. How many avoirdupois ounces of water will the bottle hold? What is the weight of the bottle?

NOTE.—To find the capacity divide the difference between the two weights by the difference between the two specific gravities.

119. How many mils would the same bottle hold? (See No. 118.)

120. What is the weight of a piece of iron 25 inches long, 4 inches wide, and 2 inches thick, its specific gravity being 7.8 (cu. in. water = 252.509 gr.)?

121. What is the capacity in mils of a vessel which will hold 2 pounds avoirdupois of glycerin?

122. If one pound avoirdupois of lead, when weighed in water, loses 611 grains, what is its specific gravity?

123. A bar of iron, when immersed in water, loses 13 per cent. of its weight. What is its specific gravity?

124. A piece of copper, when immersed, loses $\frac{1}{9}$ of its weight. What is its specific gravity?

125. A troyounce of silver, when weighed in water, weighs 434.72 grains. What is its specific gravity?

126. A druggist proposes exchanging 5 pints of phenol (specific gravity 1.065), valued at 40 cents per pound (avoirdupois), for 5 pints of glycerin (specific gravity 1.25), valued at 32 cents per pound. Does he gain or lose by the exchange, and how much?

To find the specific gravity of a liquid by immersing a solid in it: *Immerse in it a solid of known specific gravity and weight: carefully note its loss of weight when thus immersed: then use the following proportion: As its weight in air is to its specific gravity, so is its loss of weight when immersed in the liquid to the specific gravity of that liquid.* If the weight of the solid is made the same number in grains as its specific gravity, its loss of weight, when immersed in the liquid, is equal to the specific gravity of the liquid.

127. A piece of iron weighs 1560 grains; its specific gravity is 7.8. When immersed in syrup it loses 262 grains weight. What is the specific gravity of the syrup?

128. A piece of aluminum weighing 256 grains, having the specific gravity 2.56, loses 82 grains when immersed in a liquid. What is the specific gravity of the liquid? What is the liquid?

129. What is the volume of a block of ice 12 feet long, 8 feet wide, and 2 feet thick? What is its weight, and how many cubic feet of water will it yield when melted, supposing that water upon freezing increases in volume $\frac{1}{15}$? (See No. 120.)

130. How many gallons and parts and how many pounds and parts of water will it take to fill a vessel 14 inches wide, 21 inches long, and 9 inches deep (cu. in. water = 252.509 gr.)?

131. What is the specific volume of mercury?

132. What is the specific volume of diluted sulphuric acid?

133. What is the specific volume of glycerin?

134. What is the specific volume of iodoform (specific gravity 4)?

135. How much (wine measure) will one pound (avoirdupois) tincture of ferric chloride measure (specific gravity = 1.005)?

136. If 65.1 Gm. of Rochelle salt be divided into seven powders, what would be the volume of water equal to the weight of one powder?

137. How much silver nitrate must be used to make 2 fluidounces of a 4 per cent. solution of the nitrate? (See No. 17.)

138. A bottle when filled with syrup (specific gravity 1.31) contains 23.58 ounces (av.). How much nitric acid (specific gravity 1.42) will it contain?

139. A bottle when filled with syrup (specific gravity 1.31) weighs 36 ounces, 285 grains (av.), when filled with oil (specific gravity 0.9) it weighs 30 ounces, 219 grains. What is the weight of the bottle? Of the syrup? Of the oil? (See No. 118.)

140. A bottle when filled with syrup (specific gravity 1.31) weighs 34.96 ounces (av.), when filled with nitric acid (specific gravity 1.42) it weighs 36.72 ounces. What is the weight of the bottle, and how much water will it hold? (See No. 118.)

141. A bottle filled with water weighs 32 ounces (av.); when filled with chloroform (specific gravity 1.47) it weighs 39.755 ounces (av.); when filled with acid it weighs 34.64 ounces. What acid does it contain? (See No. 118.)

142. In a mixture of lard 2 pounds, wax 4 pounds, and spermaceti 1 pound, what is the per cent. of each constituent in the whole amount?

143. How many grammes of each of the foregoing ingredients would be required to make one kilogramme of the mixture?

144. If I purchase 500 grammes of ether for 75 cents, and sell 4 fluidounces for 50 cents, what per cent. profit do I make?

145. If a druggist's pound weight is 65 grains lighter than it should be, what per cent. increase of profit does he make upon goods sold by it as compared with a correct weight?

146. What will be the value of 2405.365 grammes of opium at $13.50 per kilogramme?

147. How many fluidounces of creosote are required to fill 4 gross of 5-minim capsules?

148. How much of each ingredient will be required to make 60 grammes of compound morphine powder according to the following formula:

Morphine sulphate	1.5 Gm.
Camphor	32.0 Gm.
Glycyrrhiza	33.0 Gm.
Precipitated calcium carbonate	33.5 Gm.

149. What will be the value of 125 grammes of lactucarium at $12.50 per kilogramme?

150. How many ounces avoirdupois in one pound troy?

151. How many troy ounces in one pound avoirdupois?

152. How many pounds avoirdupois in one gallon of water?

153. How many pounds troy? (See No. 152.)

154. How many pounds avoirdupois in one gallon of honey (specific gravity 1.370)?

155. What per cent. of an avoirdupois ounce is a grain?

156. What per cent. of an avoirdupois pound is a grain?

157. What factor would you use in converting fluidounces into avoirdupois ounces?

158. What factor would you use in converting avoirdupois ounces into fluidounces?

159. If I sell two-fifths of an ounce of oil of rose for three-sevenths of the cost of the entire ounce, what per cent. do I gain or lose?

160. From a one-pound can of opium the following quantities have been removed: 3 ounces, $1\frac{3}{4}$ ounces, 1.64 ounces, 175 grains, 2 grammes. How much opium remains in the can?

161. How many fluidounces will be contained in a box 5 cm. long, 5 cm. wide, and 5 cm. deep?

162. If you received an order to spread a plaster 8 by 12 cm., what size in inches would you give?

163. A druggist orders a five-inch funnel, but receives one measuring 12 cm. Is the one sent larger or smaller than the one desired, and how much?

164. If a pint of water weighs 7291.2 grains, how many grains of solid matter are present in a gallon of water containing 58 parts of solid matter in the million?

165. If a prescription calls for 75 pills each to contain 200 mg. of quinine sulphate, how many grains of quinine sulphate would be required to make the whole number of pills?

166. If I pay $1.00 a kilogramme for a substance which I sell for 10 cents an ounce retail, what per cent. profit do I make?

167. If 500 mils of official alcohol be mixed with 500 mils of water, and the contraction in volume amounts to 30 mils, what will be the per cent., by volume, of official alcohol in the resulting mixture?

168. What will be the cost of the mixture, per pint, with alcohol costing $2.40 per gallon. (See No. 167.)

169. How many mils of camphorated tincture of opium represent 1 gramme of morphine, if 1000 mils represent 4 grammes of powdered opium (12 per cent.)?

170. If tincture of opium is found to contain 1.45 grammes of crystallized morphine in each 100 mils, how much diluted alcohol must be added to each pint to reduce it to a strength of 1.2 Gm. in 100 mils?

171. How many mils of tincture of opium of the above strength can be made from 123 grammes of granulated opium, assaying 13.25 per cent. crystallized morphine? (See No. 170.)

172. If 10 avoirdupois pounds of a solution contain 8 avoirdupois ounces of sodium chloride, what is the percentage strength of the solution?

173. How much salt and how much water would be required to make 15 avoirdupois pounds of a 5 per cent. solution?

174. If 3 grammes of potassium nitrate are dissolved in 27 grammes of water, what is the percentage strength of the solution?

175. If ⅛ ounce of cocaine hydrochloride be dissolved in 1 fluidounce of water, what will be the percentage strength of the solution?

176. What will be the percentage strength of ⅛ ounce troy if dissolved in the same amount of water?

177. How much corrosive sublimate must be used to make 1 pint of a 1–2000 solution?

178. How much must be used to make a liter of a 1–3000 solution?

179. If 1 troyounce of sodium chloride be dissolved in 1 pint of water, what is the percentage strength of the resulting solution?

180. Boric acid is soluble in 18 parts of water. What is the percentage strength of a saturated solution?

181. What per cent. of sugar is there in a syrup made by dissolving 1 avoirdupois pound of sugar in 1 pint of water?

182. What will be the per cent. if 1 pound troy of sugar is used?

183. How much physostigmine salicylate will be required to make approximately 1 fluidounce of a 2 per cent. solution?

184. Potassium iodide is soluble in about three-fourths of its own weight of water. What is the percentage strength of a saturated solution?

185. How many grammes of mercuric chloride will be required to make 100 mils of a solution, 10 mils of which when added to 990 mils of water will make a solution containing the equivalent of 1 gramme in 2000 mils?

186. If the specific gravity of acetone is 0.79, what will 2 fluidounces weigh in grammes?

187. What is the value of 4 pints of glycerin, specific gravity, approximately, 1.25, at 18 cents per pound avoirdupois?

188. Which is heavier and how much, 1 fluidounce of mercury, specific gravity, approximately, 13.50, or, 1 pint oil of turpentine, specific gravity, approximately, 0.850?

189. What is the value of 5 avoirdupois pounds of spirit of nitrous ether, specific gravity 0.820, at 40 cents per pint?

190. What will be the cost of a gallon of extract of witchhazel, if the distillate costs 35 cents a gallon, and 12 per cent., by volume, of alcohol, costing $2.75 a gallon, is added to it for preservation?

191. A formula calls for 246 grammes of nitric acid, specific gravity 1.414. On account of the corrosive nature of the acid it is advisable to measure it. How many mils will be required?

192. If 1 pint of syrup, specific gravity 1.313, be mixed with 500 mils of glycerin, specific gravity 1.246, how many troyounces will the mixture weigh?

193. What size bottle in fluidounces, approximately, will be required to hold 1 avoirdupois pound of ether?

194. Five hundred grammes of chloroform? (See No. 193.)

195. One troy pound of olive oil? (See No. 193.)

196. One avoirdupois pound of bromoform? (See No. 193.)

197. One avoirdupois pound of mercury? (See No. 193.)

198. How much salicylic acid, and how much monohydrated sodium carbonate would you use to make 240 grains of sodium salicylate, when 100 parts of salicylic acid require 45.18 parts of monohydrated sodium carbonate to combine to form 115.97 parts of sodium salicylate?

199. How much of each will be required to make 100 grammes of the salt?

200. What will it cost to make a pound of sodium salicylate, if the salicylic acid costs 50 cents a pound, and the monohydrated sodium carbonate costs 15 cents a pound, allowing 10 cents for labor?

Alligation Applied to Pharmacy

(The answers to these questions will be found on page 109)

Rules for ascertaining the quantities of drugs of different percentages of strength, to be used in making a mixture of definite strength; also of liquids where no change of volume takes place when mixed.

Percentages

RULE.— *Write the percentages of the different ingredients in a horizontal row; connect with a line each percentage which is greater than that of the mixture sought with one that is less, and each one that is less than that of the mixture sought with one that is greater; then write the difference between the percentage of the mixture sought and that of each of the ingredients under the percentage of the other ingredient or ingredients with which it is connected by the line. The figures thus placed under each percentage will be found to indicate the proportionate parts (by weight) of each ingredient to be used.*

It is apparent that where there are more than two ingredients there will be an indefinite number of ratios. Either one of the ingredients of less strength than the mixture may vary, and therefore one or more of the other ingredients must vary correspondingly.

The same rules are applicable to liquids of different specific gravities (where no change of volume takes place when they are mixed), writing "specific gravities" in places of "percentages."[1]

Specific Gravities

RULE.— *Write the specific gravities of the different ingredients in a horizontal row; connect with a line each specific gravity which is greater than that of the mixture sought with one that is less, and each one that is less than that of the mixture sought with one that is greater; then write the difference between the specific gravity of the mixture sought and that of each of the ingredients under the specific gravity of the other ingredient or ingredients with which it is connected by the line. The figures thus placed under each specific gravity will be found to indicate the proportionate parts (by measure) of each ingredient to be used.*

1. In what proportion must two quantities of powdered opium, containing respectively 7 and 18 per cent. of morphine, be mixed so that the mixture shall contain 16 per cent.?

16			
7	18	*Answer*	*Proof*
2	9	2 parts of 7 per cent.	$2 \times 7 = 14$
		9 parts of 18 per cent.	$9 \times 18 = 162$
		11 parts	$11)176$
			16

2. In what proportions to yield a mixture of 12 per cent.? (See No. 1.)

3. In what proportions may three quantities, containing respectively 7, 16, and 18 per cent., be mixed so that the mixture shall contain 14 per cent.?

14				
7	16	18	*Answer*	
2	7	7	6 parts of 7 per cent.	= 42
4			7 parts of 16 per cent.	= 112
6			7 parts of 18 per cent.	= 126
			20 parts	$2.0)28.0$
				14

When there are three or more ingredients the proportion of these may be varied indefinitely, as will appear from the following:

In the preceding example suppose that only 1 part of that containing 16 per cent., and the same number of parts containing 7 per cent. as before be used, it will then require more than 7 parts of that containing 18 per cent. to make the mixture contain 14 per cent.

When the quantities of more than one ingredient are given, each quantity may be multiplied by its percentage and the sum of the products divided by the sum of the quantities; this will give the mean percentage of the quantities.

Thus 6 parts of 7 per cent.
1 part of 16 per cent. } = 7 parts of $8\frac{2}{7}$ per cent.

$6 \times 7 = 42$
$1 \times 16 = 16$
$7 \quad)58$

$8\frac{2}{7}$ per cent.

[1] Of course, mixed liquids which contract may be allowed to stand until contraction ceases, and sufficient liquid can then be added to make up the intended measure.

14

$8\frac{2}{7}$ 18

4 $5\frac{5}{7}$

and it will require 4 parts of $8\frac{2}{7}$ per cent. and $5\frac{5}{7}$ parts of 18 per cent. to make a mixture containing 14 per cent. Now if 4 parts of $8\frac{2}{7}$ per cent. require $5\frac{5}{7}$ parts of 18 per cent., then 7 parts of $8\frac{2}{7}$ per cent. will require 10 parts of 18 per cent., or $4 : 5\frac{5}{7} : : 7 : 10$; therefore the mixture will be—

6 parts of 7 per cent. $6 \times 7 = 42$
1 part of 16 per cent. $1 \times 16 = 16$
10 parts of 18 per cent. $10 \times 18 = 180$

17)238(14
17
68
68

The different percentages may be connected in various ways, care being taken that in every case one larger than the required mixture shall be connected with one smaller, but every one must be connected with some other.

4. In what proportions may four quantities, containing respectively 7, 8 16, and 18 per cent., be mixed so that the mixture shall contain 14 per cent.?

14

7 8 16 18

4 2 6 7

Answer

4 parts of 7 per cent.	=	28
2 parts of 8 per cent.	=	16
6 parts of 16 per cent.	=	96
7 parts of 18 per cent.	=	126
19 parts		19)266(14

Or,

14

7 8 16 18

2 4 7 6

Answer

2 parts of 7 per cent.	=	14
4 parts of 8 per cent.	=	32
7 parts of 16 per cent.	=	112
6 parts of 18 per cent.	=	108
19 parts		19)266(14

5. In what proportions may four quantities, containing respectively 9, 15, 16, and 18 per cent., be mixed, so that the mixture shall contain 14 per cent.?

14

9 15 16 18

1 5 5 5

2

4

7 5 5 5

6. In what proportions may five quantities, containing respectively 7, 8, 9, 11, and 16 per cent., be mixed, so that the mixture shall contain 12 per cent.?

7. How much of each kind of scammony, containing respectively 77 per cent., 83 per cent., and 92 per cent. of resin, may be used to make a mixture containing 85 per cent.?

8. How much scammony of 90 per cent. must be mixed with 7 ounces of 80 per cent. and 5 ounces of 82 per cent. to make the mixture contain 85 per cent. of resin?

7 oz. $\times$ 80 per cent. = 560
5 oz. $\times$ 82 per cent. = 410
= 12 oz. of $80\frac{5}{6}$ per cent.

12)970
$80\frac{5}{6}$

85

$80\frac{5}{6}$ 90

5 $4\frac{1}{6}$

Then if 5 ounces of the mixture require $4\frac{1}{6}$ ounces of 90 per cent., 12 ounces of mixture will require 10 ounces of 90 per cent. $5 : 4\frac{1}{6} : : 12 : 10$

7 oz. $\times$ 80 per cent. = 560
5 oz. $\times$ 82 per cent. = 410
10 oz. $\times$ 90 per cent. = 900

22 22)1870(85
176
110
110

9. What quantities (by measure) of glycerin (specific gravity 1.246) and alcohol (specific gravity 0.816) must be mixed to have the specific gravity 1.000?

1.000

1.246	0.816
184	246

184 glycerin
246 alcohol
430

184×1.246=229.264
246×0.816=200.736
430.000

430÷430=1.000

10. What quantities (by measure) of glycerin (specific gravity 1.250) and diluted alcohol (specific gravity 0.928) must be mixed to have the specific gravity 1.000?

11. How much each of alcohol 94 per cent. and 60 per cent. must be used to make 100 ounces (by weight) of 80 per cent.?

80

94	60
20	14
Or, 10	7

17 : 10 : : 100 : 58.82

100.00
58.82 of 94 per cent.
41.18 of 60 per cent.

When the quantity of one of the ingredients is given, to find the quantities of the other ingredients:

Proceed as before to find the ratios of the ingredients; then by proportion: As the ratio of that ingredient of which the quantity is given is to its quantity, so is the ratio of each ingredient to its quantity.

12. How much alcohol (specific gravity 0.820) and how much glycerin (specific gravity 1.25) must be mixed with 24 mils of syrup (specific gravity 1.31) to make 250 mils of mixture having the specific gravity 1.000 (no allowance for contraction)?

24 × 1.31 = 31.44

250 − 24 = 226

250.00 − 31.44 = 218.56

226)218.56(0.967
2034
1516
1356
1600
1582
18

24 parts specific gravity 1.310
226 parts specific gravity 0.967

0.967

0.820	1.25
283	147

283 alcohol, × 0.820 = 232.0
147 glycerin, × 1.250 = 183.5
430 415.5

430)415.5(0.966+
3870
2850
2580
2700

If 430 parts of mixture require 283 alcohol, how much will 226 require?

430 : 283 : : 226 : 148.7 ; then 226 − 148.7 = 77.3

148.7 mils alcohol, 77.3 mils glycerin, 24 mils syrup

When the quantity of more than one ingredient is given, each quantity may be multiplied by its specific gravity and the sum of the product divided by the sum of the quantities; this will give the mean specific gravity of the quantities.

13. In what proportions must 3 pints each of alcohol (specific gravity 0.935 and 0.865) be mixed with alcohol of specific gravity 0.820 so that the mixture shall have the specific gravity 0.835?

3×0.935=2805
3×0.865=2595
6 6)5400
900

3 pints of 0.935 and 3 pints of 0.865 are equal to 6 pints of 0.900 (mean specific gravity).

Then,

0.835

0.820	0.900
65	15
13	3

as 3 pints of specific gravity 0.900 are required to be mixed with 13 pints of 0.820 to make the specific gravity 0.835, so 6 pints will require twice 13 pints, or 26 pints of alcohol (specific gravity 0.820), to be added to 3 pints each of 0.865 and 0.935 to bring the whole to specific gravity 0.835.

14. How much opium containing 8 per cent. of morphine must be mixed with 10 troy ounces of opium containing 17 per cent. to make the mixture contain 12 per cent.?

15. How much opium of 16 per cent. must be mixed with 1 troy ounce of opium of 12 per cent. to make the mixture 13 per cent.?

16. How much scammony containing 92 per cent. of resin must be mixed with 1 troy ounce of 75 per cent. to make the mixture contain 85 per cent. of resin?

17. How much alcohol of 35 per cent. (by weight) will 1 quart of alcohol of 92.3 per cent. (by weight) make on dilution with water?

18. How much opium of $16\frac{1}{2}$ per cent. must be mixed with 4 ounces (10 per cent.) and 5 ounces (11 per cent.) to make the mixture 14 per cent.?

19. How much opium of $15\frac{1}{2}$ per cent. must be mixed with 3 ounces (9 per cent.), $3\frac{1}{2}$ ounces (10 per cent.), and $3\frac{1}{2}$ ounces (12 per cent.) to make the mixture contain 14 per cent.

When the quantity of the mixture and the percentages of the ingredients are given, to find the quantity of each of the ingredients:

Proceed as before to find the ratio of the ingredients, and then by proportion: As the whole amount of difference is to any one difference, so is the amount of the required mixture to the required amount of that particular difference.

20. An apothecary has opium of the following percentages of morphine,—viz.: 8, 11, 16, and 18. How much of each kind may be used to make 10 troy ounces of 12 per cent.?

12			
8	11	16	18
4	6	4	1

$4 \times 8 = 32$
$6 \times 11 = 66$
$4 \times 16 = 64$
$1 \times 18 = 18$
$15 \quad 15)180(12$
$\quad\quad 15$
$\quad\quad 30$
$\quad\quad 30$

15 : 4 : : 10 : to the required amount of 8 per cent.

4 ounces = 1920 grains 15 : 1920 : : 10 : 1280 grains

If 4 parts correspond to 1280 grains, 6 parts will correspond to 1920 grains, 4 parts to 1280 grains, and 1 part to 320 grains; thus,

1280 grains,	8 per cent.	15 : 1920 : : 10 : 1280
1920 grains,	11 per cent.	15 : 2880 : : 10 : 1920
1280 grains,	16 per cent.	15 : 480 : : 10 : 320
320 grains,	18 per cent.	

4800 grains = 10 troy ounces.

21. How many parts by weight of official alcohol (92.3 per cent.) must be added to diluted alcohol (41.5 per cent.) to make it the strength of 60 per cent. by weight?

60	
41.5	92.3
32.3	18.5

32.3 parts,	×	41.5	=	1340.45
18.5 parts,	×	92.3	=	1707.55
50.8				3048.00

$3048 \div 50.8 = 60$

22. How much of each to make 1 pound (av.) of 60 per cent.? (See No. 21.)

23. An apothecary has two kinds of opium, one $13\frac{1}{2}$ per cent., the other 16 per cent.; he desires to make 8 troy ounces of 14 per cent. How much of the weaker kind must he use?

24. I have two qualities of cinchona, containing respectively $1\frac{3}{5}$ and $3\frac{7}{8}$ per cent. of quinine. How much of each shall I take to make the mixture contain 2 per cent.?

2	
$1\frac{3}{5}$	$3\frac{7}{8}$
$1\frac{7}{8}$	$\frac{2}{5}$

$1\frac{7}{8}$ oz.	=	900 grains,	75
$\frac{2}{5}$ oz.	=	192 grains,	16

25. Two qualities contain $1\frac{5}{16}$ of 1 per cent. and $3\frac{1}{4}$ per cent. respectively. How much of each shall I take to make the mixture contain 2 per cent.?

26. Two qualities contain 1.235 per cent. and 2.345 per cent. respectively. How much of each shall I take to make the mixture contain 2 per cent.?

27. Two qualities contain 1.676 per cent. and 3.188 per cent. respectively. How much of each shall I take to make the mixture contain 2 per cent.?

28. Three qualities contain 0.840 per cent., 1.848 per cent., and 2.688 per cent. respectively. How much of each shall I take to make the mixture contain 2 per cent.?

29. Having the three qualities, as before (see No. 28), and having 5 ounces of the percentage 0.840, how much of the mixture will it yield?

If 43 parts are equal to 5 oz.,	0.840
82 parts are equal to 9 oz., 256¾ grains,	2.688
43 parts are equal to 5 oz.,	1.848

oz. 19 + 256¾ grains

30. Having the three qualities, as before (see No. 28), with 5 ounces of the percentage 0.840, and wishing to make 32 ounces of the mixture, how much of each of the others must be used?

In this case proceed to find by previous rules how much of percentage 2.688 will be required to mix with the 5 ounces, 0.840, to make the mixture 2 per cent.

This amount of mixture subtracted from 32 ounces will give the amount remaining to be made up of the other two percentages,—1.848 and 2.688.

2

0.840	2.688
0.688	1160
86	145

86 : 5 : : 145 : 8.4302

5.0000 oz.	of	0.840
8.4302 oz.	of	2.688
13.4302 oz.	of	2 per cent.

Subtracting this from 32 ounces leaves 18.5698 ounces to be made up.

2

1.848	2.688
0.688	152
86	19

86
19

105 : 18.5698 oz. : : 86 : 15.2095 oz. of 1.848

Or, subtracting this from 18.5698 ounces gives 3.3603 of 2.688; adding 8.4302 gives the whole amount used of 2.688 per cent. = 11.7905.

31. A solution of ferric sulphate is found to have the specific gravity 1.6520. How much water must be added to make it of the official strength (1.432)?

1.432

1.6520	1.000
0.4320	0.2200
Or, 43.20	22.00

43.20 fl. oz. of solution
22.00 fl. oz. of water

32. How much water must be added to 5 pints of solution of ferric sulphate (specific gravity 1.6520) to make it of the official strength?

33. A solution of ferric sulphate is found to have the specific gravity 1.412. How can it be made of the official strength?

The easiest method is to evaporate a portion of it until its specific gravity is considerably above the official strength (1.432), and then mix the proper quantities of the two solutions.

Suppose a portion of it has been evaporated until it has the specific gravity 1.448. How much of each solution must be taken to make 36 fluidounces of specific gravity 1.432?

1.432

1.412	1.448
16	20
Or, 4	5

16 fl. oz. of 1.412 } = 36 fl. oz. of 1.432
20 fl. oz. of 1.448 }

34. How much water must be added to 2 pounds of stronger ammonia water (28 per cent.) to reduce it to ammonia water (10 per cent.)?

10

28	0
10	18

10 : 18 : : 32 : 57.6 oz. water

35. How much water must be used to make 2 pounds of 10 per cent. ammonia water?

36. How much official alcohol (U. S. P. IX) (94.9 per cent. by volume) must be added to 2 pints of alcohol of 76 per cent. (vol.) to make it 81 per cent. (vol.) (no allowance for contraction)?

37. How much official alcohol (U. S. P. IX) (94.9 per cent. by volume) must be added to 2 pints of 70 per cent. (by volume) to make the mixture 85 per cent. by weight, 87.8 by volume (no allowance for contraction)?

38. In what proportion must powdered nux vomica, assaying 1.03, 1.10, 1.32, and 1.28 per cent. strychnine, be mixed in order to obtain a product containing 1.25 per cent. strychnine?

39. If 1000 grammes of the mixture are desired, how much of each must be used? (See No. 38.)

40. How much water must be added to 100 mils of 92.5 per cent. sulphuric acid (specific gravity 1.826) to make the official 10 per cent. acid?

41. How much water will be required for 100 grammes of the acid? (See No. 40.)

42. If 1000 mils of the diluted acid (specific gravity 1.067) are desired, how many grammes of the strong acid will be required?

43. How much menstruum must be added to 500 mils of a fluidextract of coca, assaying 0.58 grammes of alkaloids to 100 mils, to reduce it to the strength of 0.50 grammes of alkaloids to 100 mils?

44. How many pints of 10 per cent. ammonia water (specific gravity 0.958) can be made from 500 mils of 28 per cent. ammonia water (specific gravity 0.897)?

45. How many pints of the weaker can be made from 500 grammes of the stronger? (See No. 44.)

46. How much milk sugar must be added to 125 grammes of extract of belladonna, assaying 1.48 per cent. of alkaloids, to reduce it to the strength of 1.40 per cent.?

47. How much 36 per cent. acetic acid can be made from 127 grammes of 99 per cent. acetic acid?

48. How many fluidounces of water will be required to dilute 1 pound av. of a 12 per cent. solution of potassium hydroxide so as to make it 5 per cent.?

49. What will be the total weight of the product in grammes? (See No. 48.)

50. If a druggist has two lots of fluidextract of cinchona, assaying 3.52 and 4.84 grammes of ether-soluble alkaloids to each 100 mils, how can he mix them so as to obtain a product containing 4 Gm. of ether-soluble alkaloids in each 100 mils?

ANSWERS TO PRACTICAL PROBLEMS AND EXERCISES

(See page 95)

[The answers to these questions have been worked out from the data given in the problems or chapters, but may vary slightly from other results on account of the use of metric or other equivalents not given in this book, or because in the answer or in some of the results leading to it, the decimals have not been carried out far enough or perhaps too far.]

1. *Ans.* 700 grains each of powdered ipecac and opium and 5600 grains of powdered sugar of milk. **2.** Ten per cent. each of powdered ipecac and opium and 80 per cent. of powdered sugar of milk. **3.** 3195 grains. **4.** 3775 grains. **5.** 34 cents. **6.** 128. **7.** 7680. **8.** 9600. **9.** 1750. **10.** 1822.8. **11.** 1920. **12.** 48+ (1 pint=7291.2 grains). **13.** 41.66+. **14.** 80. **15.** Linseed oil, f℥ii; lime water, f℥iv. **16.** Six. **17.** Place 4.55 grains (1 per cent. of 455 grains) of cocaine hydrochlorate in a graduate, and dissolve it in enough distilled water to make a fluidounce; or, more conveniently, dissolve 5 grains in 1 fl. oz. 40 minims of water and use 1 fl. oz. of the solution. **18.** Strychnine, 2 grains; quinine, 128 grains; ferric phosphate, 256 grains. **19.** $1.20. **20.** He would lose $1. **21.** 7500 mm. **22.** 8.0623 M. **23.** 6.30 M. **24.** 12.543 M. **25.** 12.543 M. **26.** 1.001 M. **27.** Twenty-five dekameters. **28.** Twenty-five decimeters. **29.** Yes. **30.** One meter and twenty centimeters. **31.** $1.2 is an unusual way of expressing one dollar and two-tenths; one dollar and two dimes is also unusual; but one dollar and twenty cents is common. **32.** Four thousand two hundred and sixty-three meters and six hundred and seventy-eight millimeters. **33.** 81.396 M. (Place each row in position, beginning at the right-hand column, and add in the usual manner; if 816 cm. is to be placed, beginning with 6 in the centimeter place, and 8 would be in the meter place, thus 8.16; 732 dm. would be 73.2, while 36 mm. would be 0.036)—

$$\begin{array}{r} 8.16 \\ 73.2 \\ 0.036 \\ \hline 81.396 \end{array}$$

34. 0.015 M. **35.** 473.016 M. **36.** 500. **37.** 8.36 sq. M. **38.** 8.3608 sq. M. **39.** 3.030303 sq. M. **40.** 20.202020 sq. M. **41.** 505.0005 sq. M. **42.** 1,000,000. **43.** 63.063063063 cu M. **44.** 1000. **45.** A liter. **46.** 50. **47.** 174.625 L., or 174 L. 625 mils. **48.** Oil of juniper, 2 Gm.; oil of caraway, oil of fennel, each 0.20 Gm.; alcohol, 600 Gm.; water, 397.60 Gm. **49.** Oil of juniper, 14 grains; oil of caraway, oil of fennel, each 1.4 grains; alcohol, 4200 grains; water, 2783.2 grains. **50.** 82.28+. **51.** 61.69+ fl. oz. (7291.2×1.387, the sp. gr. of solution of ferric chloride (see page 97)=10112.894, the weight of one pint of solution of ferric chloride; 10112.894×37.8=3822.6740832, the number of grains of anhydrous salt in one pint of solution of ferric chloride; 10 times this amount (10×3822.6740832) equals the weight in grains of a solution containing 10 per cent. of anhydrous salt, 38226.740 grains; now if the weight of one pint of solution of ferric chloride be subtracted from it, the remainder must be the number of grains of water to be added to make the whole 10 per cent., 38226.740−10112.894=28113.846; then 28113.846÷455.7 (the number of grains in a fluidounce of water)=61.69+ fl. oz.). **52.** 7.161+ fl. oz. solution, 8.839+ fl. oz. water. **53.** 15 per cent. **54.** 5.5 grains. **55.** 377 grains. **56.** 16 minims. **57.** 480. **58.** 630 grains. **59.** 604.83+ grains. **60.** 497.6+ grains. **61.** $\frac{3}{64}$. **62.** 3235.47 grains. **63.** 25.277+ grains. **64.** 28.709+ grains. **65.** 3059 grains. **66.** 4932.32 grains. **67.** 38.53+ grains. **68.** 15.6 minims. **69.** 3758.75+. **70.** 103.78+ minims. **71.** 1800. **72.** 61.025+ (gallon=231 cu. in.). **73.** 0.4731+. **74.** 28316.26+. **75.** 946.32+. **76.** 2113.4+. **77.** 270.52+. **78.** 453.59+. **79.** 1370.17+. **80.** 373250.38+. **81.** 91.44+. **82.** 189. **83.** 1021.2. **83*a*.** 1.0212. **83*b*.** 1021200. **84.** 1609.329+. **85.** 721.65+. **86.** 178.56. **87.** 5 oz., 262.5 grains. **88.** 20. **89.** 3.47+ grains. **90.** 0.324 Gm., 5 grains nearly. **91.** 5248 grains. **92.** 30 lbs. troy, or 24 lbs. 10 oz. 425 gr. av. **93.** 10 lbs. troy, or 8 lbs. 3 oz. 287.5 gr. av. **94.** 8 lbs. 9 oz. troy weight, or 7 lbs. 3 oz. 87.5 gr. av. **95.** 4.4. **96.** 4.2. **97.** 11.45. **98.** 6.49. **99.** 1÷6.49=0.154+. **100.** 4.680 kilogrammes. **101.** 625 centimeters. **102.** 21.84 kilogrammes. **103.** 11.5

104. 4.2. **105.** 0.960+. **106.** 1.476+ chloroform. **107.** 1.246 glycerin. **108.** 589.58+. **109.** 36.848. **110.** 698.41+. **111.** 43.65+ Gm. **112.** 0.4731+. **113.** $\frac{1}{1024}$. **114.** $\frac{1}{1920}$. **115.** $\frac{3}{35}$ (Oi=473.11 mils). **116.** 0.845.

68.25	177.45	210)177.45(0.845
35.7	32.55	1680
32.55	210.00	945
		840
		1050
		1050

117. 400 grams. **118.** 16 oz. av. Weight of bottle 15 oz. av. **119.** 454.21+ (Oi=473.11 mils). **120.** 56 lbs. 4 oz. 164.04 gr. av. **121.** 726.74+ (Oi=473.11 mils). **122.** 11.45+. **123.** 7.69+. **124.** 9. **125.** 10.6+. **126.** 5 pints phenol cost \$2.21+, 5 pints glycerin cost \$2.08+; the druggist therefore loses 13+ cents. **127.** 1.31. 1560 : 7.8 : : 262 : 1.31. **128.** 0.820 alcohol. **129.** 11220 lbs. 399.360 gr. av. (1 cu. in. 252.509 grains)=180 cubic feet; volume=192 cubic feet. **130.** 11 gallons 3 pints 10.18 fl. oz., or 95 lbs. 7 oz. 76.314 gr. av. **131.** 0.0738+. **132.** 0.9372+. **133.** 0.8025. **134.** 0.25. **135.** 15.28 fl. oz. **136.** 9.3 mils. **137.** 36.456 grains (see answer to No. 17). **138.** 25.56 oz. av. **139.** Weight of the bottle, 7436.94 grains; weight of the syrup, 8598.06 grains; weight of the oil, 5907.06 grains. **140.** Weight of the bottle, 6125 grains; weight of the water, 7000 grains. **141.** Weight of the water, 16.5 oz. av.; weight of acid, 19.14 oz. av.; sp. gr. 1.16; hydrochloric acid. **142.** Lard, 28.57 per cent.; wax, 57.14 per cent.; spermaceti, 14.29 per cent. **143.** 285.71 Gm. lard; 571.43 Gm. wax; 142.86 Gm. spermaceti. **144.** 296+ per cent. profit.

500 Gm. ether=7716.2 grains
4 fl. oz. water=1822.8 grains
1822.8×0.716=1305.1, weight of 4 fl. oz. ether
7716.2 : 75 : : 1305.1 : X=12.6+ cents, cost of ether
50−12.6=37.4 cents profit
12.6 : 100 : : 37.4 : X=296+

145. 0.928 per cent. **146.** 32.47. **147.** 6 fl. oz. **148.** Morphine sulphate, 0.9 Gm.; camphor, 19.2 Gm.; glycyrrhiza, 19.8 Gm.; prec. calc. phosph. 20.1 Gm. **149.** \$1.56+. **150.** 13 oz. 72½ grains (13.166 oz.). **151.** 14 oz. 280 grains (14.58 oz.). **152.** 8.3328 lbs. av. **153.** 10.126 lbs. troy. **154.** 11.415 lbs. av. **155.** 0.2286 per cent. **156.** 0.0143 per cent. **157.** 1.0416. **158.** 0.9600615. **159.** 7.14 per cent. **160.** 3998.5+ grains. **161.** 4.227. **162.** About 3⅛ by 4⅘ inches. **163.** 5 inches= 12.7 cm. The funnel is 0.7 cm. or about ⅓ inch too small. **164.** 3.3831 grains. **165.** 231.5 grains. **166.** 252+ per cent. **167.** 51.54 + per cent. **168.** 15.4+ cents. **169.** 2083+ mils. **170.** 3 fl. oz. 157 minims. **171.** 1358.125 mils **172.** 5 per cent. **173.** 12 oz. av. salt, 14½ lbs. water. **174.** 27+3=30 Gm. of total solution. 3÷30=0.10 or 10 per cent. **175.** 437.5÷8=54.7 grains; this added to 455.7 grains= 510.4 grains total solution; 54.7÷510.4=0.107+ or 10.7 per cent. **176.** 480÷8=60 grains+455.7 grains=515.7 grains total solution. 60÷515.7=0.116 or 11.6 per cent. **177.** 3.64+grains. **178.** 0.333 Gm. **179.** 6.17+ per cent. (480+7291.2=7771.2; 480÷7771.2=0.0617). **180.** 18+1=19 parts total. 1÷19=0.05263=5.26 per cent. **181.** 48.98 per cent. 7291.2+7000=14291.2; 7000÷14291.2=.4898 or 48.98 per cent. **182.** 5760+7291.2=13051.2; 5760÷13051.2=0.4413 or 44.13 per cent. **1.83** 9.1 grains. **184.** 57.14 per cent. **185.** 5 Gm. **186.** 46.65 Gm. **187.** 93+ cents. **188.** Oil of turpentine heavier by 45.57 grains. **189.** \$2.34. **190.** 63+ cents a gallon. **191.** 173.97 mils. **192.** 39.9 troy oz. **193.** 22 fl. oz. **194.** 12 fl. oz. **195.** 14 fl. oz. **196.** 6 fl. oz. **197.** 2 fl. oz. (actual measure 1.14 fl. oz.). **198.** Salicylic acid, 207 grains; monohydrated sodium carbonate, 93 grains. **199.** 86.2 Gm. salicylic acid, 38.7 Gm. monohydrated sodium carbonate. **200.** 58.9+ cents.

ALLIGATION

1. 2 parts of 7 per cent. and 9 parts of 18 per cent. **2.** 6 parts of 7 per cent. and 5 parts of 18 per cent. **3.** 6 parts of 7 per cent., 7 parts of 16 per cent., and 7 parts of 18 per cent. **4.** 4 parts of 7 per cent., 2 parts of 8 per cent., 6 parts of 16 per cent., 7 parts of 18 per cent., or 2 parts of 7 per cent., 4 parts of 8 per cent., 7 parts of 16

per cent., 6 parts of 18 per cent. **5.** 7 parts of 9 per cent., 5 parts each of 15, 16, and 18 per cent. **6.** 4 parts of 7 per cent., 4 parts of 8 per cent., 4 parts of 9 per cent., 4 parts of 11 per cent., and 13 parts of 16 per cent.

12

7 8 9 11 16

4 4 4 4 5
4
3
1

4 4 4 4 13

7. 7 parts of 77 per cent. 539
7 parts of 83 per cent. 581
10 parts of 92 per cent. 920
24 24)2040
85

85

77 83 92

7 7 2
8

7 7 10

8. 10 oz. **9.** 184 parts of glycerin and 246 parts of alcohol. **10.** 36 parts of glycerin and 125 parts of diluted alcohol. **11.** 58.82 ounces of 94 per cent. and 41.18 ounces of 60 per cent. **12.** 148.7 mils of alcohol, 77.3 mils of glycerin, and 24 mils of syrup. **13.** 26 pints of 0.820, 3 pints each of sp. gr. 0.935 and sp. gr. 0.865 **14.** $12\frac{1}{2}$ troy ounces.

12

8 17

5 4

$4 : 5 : : 10 : 12\frac{1}{2}$

$10 \times 17 = 170$
$12\frac{1}{2} \times 8 = 100$
$22\frac{1}{2}$ 270

$270 \div 22\frac{1}{2} = 12$ per cent.

15. 160 grains.

13

12 16

3 1

$3 : 480 : : 1 : 160$

16. $685\frac{5}{7}$ grains.

85

75 92

7 10

$7 : 480 : : 10 : 685\frac{5}{7}$

17. 72.16 oz. av. (7291.2×2×0.816=11899.238 grains in a quart of U. S. P. alcohol; and 11899.238×0.923=10982.997 grains of absolute alcohol (92.3 per cent. absolute alcohol in U. S. P. alcohol).

35 parts of alcohol (92.3 per cent.) require 57.3 parts of water to make the mixture 35 per cent.; then as 35 : 57.3 : : 11899.238: 19680.466 and 19680.466+11899.238÷437.5=72.16 oz. av.

35

92.3 0

35 57.3

18. 12.4 oz.

14

$10\frac{5}{9}$ $16\frac{1}{2}$

$2\frac{1}{2}$ $3\frac{4}{9}$

4 oz. 10 per cent.=40
5 oz. 11 per cent.=55
9 95

$95 \div 9 = 10\frac{5}{9}$ per cent.

$2\frac{1}{2} : 9 : : 3\frac{4}{9} : 12.4$

19. 24 oz.

3 oz. 9 per cent.= 27
$3\frac{1}{2}$ oz. 10 per cent.= 35
$3\frac{1}{2}$ oz. 12 per cent.= 42
10 104

14

10.4 15.5

1.5 3.6

$104 \div 10 = 10.4$ per cent.

$1.5 : 10 : : 3.6 : 24$

20. 1280 grains 8 per cent., 1920 grains 11 per cent., 1280 grains 16 per cent. and 320 grains 18 per cent. **21.** 18.5 parts to every 32.3 parts. **22.** 5 oz. 362+ grains. 50.8 : 18.5 : : 7000 grains : 2550 grains.

23. 6℥ 192 grains.

For one part of 16 per cent. he must use 4 parts of $13\frac{1}{2}$ per cent., or $\frac{4}{5}$ of the whole amount of $13\frac{1}{2}$ per cent. $\frac{4}{5}$ of 8 oz. = 6 oz. 192 grains.

$$\begin{array}{c} 14 \\ \hline 16 \quad 13\frac{1}{2} \\ \hline \frac{1}{2} \quad 2 \end{array}$$

24.

$$\begin{array}{c} 2 \\ \hline 1.6 \quad 3\frac{7}{8} \\ \hline 1\frac{7}{8} \quad .4 \end{array}$$

$1\frac{7}{8}$ oz. = 900 grains
$\frac{4}{10}$ oz. = 192 grains
or in the proportion of 75 to 16.

25. 20 parts of $\frac{1}{16}$ths of 1 per cent. and 17 parts of $3\frac{1}{4}$ per cent. **26.** 23 parts of 1.235 per cent. and 51 parts of 2.345 per cent. **27.** 11 parts of 1.676 per cent. and 3 parts of 3.188 per cent. **28.** 43 parts of 0.840 per cent., 43 parts of 1.848 per cent., and 82 parts of 2.688 per cent. **29.** 19 oz. $256\frac{3}{4}$ grains. If 43 parts are equal to 5 oz., then by proportion 82 parts are equal to 19 oz. $256\frac{3}{4}$ grains. **30.** 5 oz. of 0.840 per cent., 11.7905 oz. of 2.688 per cent., and 15.2095 oz. of 1.848 per cent. **31.** 43.2 oz. of solution, 22 oz. of water. **32.** 2 pints 8 fl. oz. 353 min. **33.** 16 fl. oz. of 1.412, 20 fl. oz. of 1.448. **34.** 57.6 fl. oz. water. **35.** $20\frac{4}{7}$ oz. 28 : 18 : : 32 : $20\frac{4}{7}$. If in 28 oz. there are 18 oz. water, then 32 oz. will require $20\frac{4}{7}$ oz. **36.** 11.5+ fl. oz.

$$\begin{array}{c} 81 \\ \hline 94.9 \quad 76 \\ \hline 5 \quad 13.9 \end{array}$$

13.9 : 5 : : 32 : 11.5

37. 80 fl. oz. 76.8 min. **38.** 3 parts of 1.03 per cent., 7 parts of 1.10 per cent., 15 parts of 1.32 per cent., and 22 parts of 1.28 per cent. **39.** 63.8 Gm. of 1.03 per cent., 148.9 Gm. of 1.10 per cent., 319.2 Gm. of 1.32 per cent., and 468.1 Gm. of 1.28 per cent. **40.** 1506.4 Gm. **41.** 832.5 Gm. **42.** 115.35 Gm. **43.** 80 mils. **44.** 2.77+ pints. **45.** 3.08+ pints. **46.** 7.14 Gm. **47.** 349.2 Gm. **48.** 21.5+ fl. oz. **49.** 1088.6+ Gm. **50.** 84 parts of 3.52 to 48 parts of 4.84.

QUESTIONS ON METROLOGY

Define Metrology. (See page 41.)
What does its present and less strict definition include?
What is weight?
What is measure?
What is specific gravity?
In the history of Metrology, how many distinctly-marked periods may be traced?
Describe the peculiarities of each period.
What was the original weight of the English silver penny?
What is the origin of the avoirdupois pound?
How did the custom originate of druggists using one system of weights for buying drugs and another for compounding them?
When were the Imperial measures and standards adopted in Great Britian?
What relation does the yard bear to the length of a pendulum beating seconds?
What is the weight in grains of the pound troy?
What is the weight in grains of the pound avoirdupois?
What is the weight in grains of a cubic inch of distilled water.
What is the weight of an Imperial gallon of distilled water?
What is the weight of a wine gallon of distilled water?
How many cubic inches does a wine gallon contain?
How is the pound troy divided?
How is the pound avoirdupois divided?
What is the difference in grains between the troy ounce and the avoirdupois ounce?
What is the difference in grains between the troy pound and the avoirdupois pound?
How is the U. S. wine gallon divided?
How is the Br. Imperial gallon divided?
What is the weight in grains of a pint of distilled water at 15.6° C.? At 25° C.?
What is the weight in grains of a fluidounce of distilled water at 15.6° C.? At 25° C.?
What is the weight in grains of a troy ounce of distilled water at 15.6° C.? At 25° C.?
What is the weight in grains of an avoirdupois ounce of distilled water?
What is the weight in grains of an Imperial fluidounce of distilled water (Br.)?
What is the estimated capacity of a tumblerful? A teacupful? A wineglassful? A tablespoonful? A dessertspoonful? A teaspoonful?
Can ordinary household teaspoons, tablespoons, etc., be relied upon for accurate dosage? What is recommended for use in measuring such doses?
What is the standard or unit of measurement in the metric or decimal system?
How is it derived?
Why is the system called the metric system?
Why is the system called the decimal system?
How is the unit of capacity derived?
How is the unit of weight derived?
How are the multiples of the various units expressed?
How are the divisions of the various units expressed?
What word has been suggested as a useful mnemonic?
Give the names of the various denominations of length.
Give the names of the various denominations of capacity.
Give the names of the various denominations of weight.
Which of these terms are used in the U. S. Pharmacopœia?
What is the meaning of a micromillimeter?
What term has replaced "cubic centimeter" in the U. S. P. and other standard books?
What difference is recognized in the value of cubic centimeter and the new term which has replaced it?
What are the chief merits of the metric system?
What is the length of a meter?
What is the capacity of the liter in pints?
What is the measure of a gramme of distilled water?
What is the weight of a gramme in grains?
What is the chief disadvantage of the metric system?
How are the metric weights usually divided?
How can you convert meters into inches?
How can you convert centimeters into inches?

How can you convert millimeters into inches?
How can you convert liters into fluidounces?
How can you convert liters into pints?
How can you convert liters into Imperial pints?
How can you convert liters into Imperial gallons?
How can you convert mils into fluidounces?
How can you convert mils into Imperial fluidounces?
How can you convert grammes into grains?
How can you convert grammes into avoirdupois ounces?
How can you convert grammes into troy ounces?
How can you convert centigrammes into grains?
How can you convert milligrammes into grains?
How can you convert kilogrammes into avoirdupois ounces?
How can you convert kilogrammes into avoirdupois pounds?
How can you convert kilogrammes into troy ounces?
How can you convert inches into meters?
How can you convert inches into centimeters?
How can you convert inches into millimeters?
How can you convert pints into liters?
How can you convert fluidounces into mils?
How can you convert Imperial pints into liters?
How can you convert Imperial gallons into liters?
How can you convert Imperial fluidounces into mils?
How can you convert grains into grammes?
How can you convert grains into centigrammes?
How can you convert grains into milligrammes?
How can you convert avoirdupois ounces into kilogrammes?
How can you convert avoirdupois ounces into grammes?
How can you convert avoirdupois pounds into kilogrammes?
How can you convert troy ounces into kilogrammes?
How can you convert troy ounces into grammes?
How are the metric units spelled by the French?
How are the metric units spelled by the U. S. Pharmacopœia?
How should 0.050 m. be read?
How should 0.055 m. be read?
How should 0.0555 m. be read?
In measures of capacity less than a liter, what terms are used?
In weight, when the quantity is relatively large, what terms are used?
In quantities less than a kilogramme and greater than a gramme, what terms are used?
In quantities below the gramme, what terms are used?
What is a balance?
What points are necessary in constructing a balance to obtain correct results?
Name the various kinds of pharmaceutical balances in use.
Describe a single beam, equal arm balance.
Where should the centre of gravity be when the beam is in a horizontal position?
Give a simple illustration of the principle of suspending a beam.
What particulars are necessary in regard to the end knife-edges?
What is the effect if the end knife-edges are not equidistant from the central knife-edge?
What if the central knife-edge is not in line with the end knife-edges?
What if the knife-edges are not parallel with each other?
What are the requisites for the beam of a fine balance in order to secure accuracy in weighing?
Why should the beam of the balance be rigid and non-elastic?
Why should it be no heavier than necessary in order to secure the requisite strength?
What advantages have agate knife-edges and planes over those made of steel?
How may a balance be tested for accuracy?
What are the advantages of having the balance supported by a rigid metallic column?
Wherein does an analytical balance differ from an ordinary prescription balance?
Describe the Becker chain balance.
What sort of counter scales was formerly in use?
What has taken its place generally in more recent times?

Upon what principle are the single beam, unequal arm balances constructed?
What are the advantages of the "Ball scale"?
Describe the vest-pocket prescription balance?
Describe the double beam, unequal arm balance.
What are its advantages?
Describe a scale made to weigh liquids.
What is the principle objection to such balances?
What principle is adopted in making platform scales?
Describe the construction of a "compound lever balance." What are the advantages of such a balance?
What is a "box prescription scale"?
Is such a scale suitable for weighing quantities of a grain or less?
What is the principle of the torsion balance?
Of what weights does a pile of avoirdupois weights consist?
What is meant by block weights?
What is the objection to the use of a wooden block?
How are troy weights usually arranged?
How are iron metric weights usually shaped?
What weights are generally used for analytical purposes?
What is the best material and form for grain weights for prescription purposes?
Why are aluminum weights preferable to brass?
What are the advantages of aluminum wire weights?
What measures are commonly used for measuring liquids when the quantity is more than a pint?
What when the quantity is one pint or less?
What effect has denting upon tinned iron or copper measures?
Describe the forms of graduated glass measures in common use.
Which is preferable, and why?
Describe Hodgson's graduated measures.
Describe Hobb's graduated measures.
What is an objection to either of these, and how may it be remedied?
What objection is there to using minim graduated measures?
How may greater accuracy be obtained?
How is a pipette used?
Do the terms minim and drop always mean the same?
About how many drops are there in a fluidrachm of water? *Ans.* 60.
In a fluidrachm of syrup of acacia? *Ans.* 44.
In a fluidrachm of chloroform? *Ans.* 250.
In a fluidrachm of tincture of opium? *Ans.* 130.
What is specific gravity?
How much weight does a body lose by being immersed in water?
What is the rule for finding the specific gravity of a body?
How is the specific gravity taken of a solid, insoluble in but heavier than water, by means of a balance?
How by means of a specific gravity bottle?
How by means of a graduated tube?
How by immersing it in a liquid of the same specific gravity?
How is the specific gravity taken of a solid, soluble in but heavier than water?
How is the specific gravity taken of a solid, insoluble in but lighter than water?
How of a solid soluble in but lighter than water?
Describe a specific gravity bottle.
Can an ordinary bottle be used for this purpose?
State how this can be done?
What are Lovi's or specific gravity beads?
What is a hydrometer or areometer?
What two classes of hydrometers are there?
Describe Baumé's hydrometer.
What is the difference between the one for light liquids and the one for heavy liquids?
Why is the zero mark placed near the top in hydrometers for heavy liquids?
Describe the specific gravity scale hydrometer.
What is the object of having two bulbs blown in the glass at the lower end of the hydrometer?
Which is the more accurate for taking specific gravity,—the hydrometer or the specific gravity bottle,—and why?

Which is more likely to give a correct indication of specific gravity,—a hydrometer having an elongated bulb with cylindrical sides, or one having an oval or globular bulb,—and why?
What is a urinometer, and how is it usually graduated?
What is the specific gravity of healthy urine?
What is the specific gravity of diabetic urine?
What is a saccharometer, and how is it graduated?
What is an elæometer?
What is a lactometer?
What does an alcoholmeter usually indicate?
Describe Tralles's hydrometer.
Describe Cartier's hydrometer.
Describe Gay-Lussac's centesimal alcoholmeter.
Describe Sikes's hydrometer.
Describe Jones's hydrometer.
Describe Dica's hydrometer.
Describe Twaddell's hydrometer.
Describe Beck's hydrometer.
Describe Zanetti's hydrometer.
Describe Fahrenheit's hydrometer.
Describe Nicholson's hydrometer.
Describe Mohr's specific gravity apparatus.
Describe the Westphal specific gravity balance.
Describe Gannal's method of taking specific gravity of a liquid.
How can a specific gravity pipette be used to show specific gravity?
Describe Rousseau's densimeter.
What is specific volume?
How can you obtain the volume of a given weight of a liquid?

CHAPTER II

OPERATIONS REQUIRING THE USE OF HEAT

Generation of Heat

THE consideration of the theories which have been advanced from time to time to explain the phenomenon of heat, although very interesting and instructive, cannot be treated of in a work of this character, and the reader is therefore referred to any of the recent works on physics, which are everywhere accessible. The view which is now almost universally accepted is that known as the dynamical theory of heat, in which it is assumed that heat is produced by the constant motion of the particles composing the body, and that heat varies in quantity according as the body is *solid*, *liquid*, or *gaseous*.

It will be convenient to consider the various practical operations and appliances for generating heat under four heads:

1. Operations and forms of apparatus in which *solids* are used in developing heat.
2. Those in which *liquids* are used in developing heat.
3. Those in which *gases* are used in developing heat.
4. Those in which *electricity* is used in developing heat.

Operations and Forms of Apparatus in which Solids are used in developing Heat

Kinds of Fuel.—Under this head is included the very well known employment of solid fuel, as wood, charcoal, anthracite coal, bituminous coal, coke, etc.

Wood is seldom relied upon as fuel in pharmaceutical operations where a regular, well sustained heat is desired, yet from its wide distribution, ready inflammability, and comparative cheapness it is indispensable in kindling a fire. The large quantity of unconsumed carbon which is either lost in smoke or deposited upon vessels that are being heated constitutes the chief objection to its use.

Charcoal is more convenient, although more costly, than wood. It ignites easily, burns readily, and leaves but little residue. On account of its ready combustibility, it is well fitted for operations requiring a quick, strong heat.

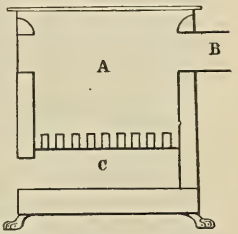
Anthracite coal is probably the best form of solid fuel for general use, being the most economical. Its hard, dense structure renders it difficult to kindle, but where a long continued, strong heat is desired it is to be preferred.

Bituminous or *semibituminous coal* affords a strong heat, but it is not equal to anthracite as fuel for pharmaceutical purposes. Unconsumed carbon is found in the smoke in large quantity, and this is apt to condense on the surfaces of kettles, vessels, etc., which are being heated, and the deposits of soot are uncleanly and often difficult to remove.

Coke, the residue obtained from the distillation of coal at gasworks, is an excellent fuel, and may be used either mixed with coal or by itself. It is more easily kindled than anthracite.

Pharmaceutical Furnaces, etc.—Much ingenuity has been used in the contrivance of various forms of furnaces, ranges, stoves, etc., to meet general or special applications, yet in all there are certain fundamental principles of construction which must be well understood if faults are to be avoided. The elements of a furnace are the *airflue*, *combustion chamber*, and *vent* or *chimney*, and the relative proportions of these must depend upon the special object sought in the construction of the furnace, and the character of the fuel that is to be used. Fig. 63 represents a sectional view of a pharmaceutical furnace,—C being the airflue, A the combustion chamber, and B the vent.

FIG. 63



Pharmaceutical furnace, sectional view

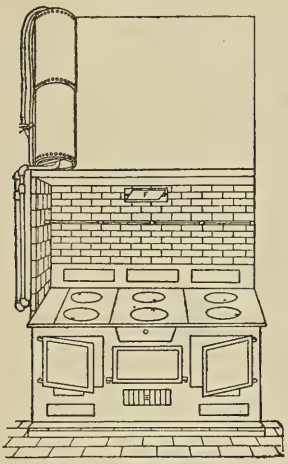
Coal being the principal solid fuel in use, it will be most appropriate to treat of those furnaces adapted for its combustion, and therefore the chemical constitution of coal and the theory of its combustion must be noticed. Hard anthracite, which is the best kind of coal for pharmaceutical furnaces, usually has a specific gravity of 1.550, and has been shown to consist of 94 per cent. carbon, 0.40 per cent. hydrogen, and 1.26 per cent. oxygen; there are also apt to be present 2 per cent. of water and about 2.3 per cent. of incombustible impurities or ash, consisting of ferric oxide, silica, alumina, magnesia, lime, etc. The poorer grades of this kind of coal contain from 85 to 90 per cent. of carbon. Anthracite may be distinguished from other varieties by its rich, glassy lustre, its peculiar conchoidal fracture, and its hard, dense structure. It burns freely, without black smoke, showing the absence of unconsumed carbon. Soft anthracite or *semi-bituminous* coal has a tendency, when broken into pieces, to assume the form of irregular cubes, and to crumble easily under pressure. It burns freely, but with the production of large quantities of black smoke. The heat produced by its combustion is very strong, and it is largely used in many parts of the United States.

The combustion or oxidation of coal requires the presence of a certain quantity of air in contact with the burning coal to furnish enough oxygen to combine properly with the carbon of the fuel. The result of the combination is carbon dioxide, CO_2, and carbon monoxide, CO, both of which are gases. It is very important to provide means of escape for these gaseous compounds, as they are both poisonous, and the former is a decided non-supporter of combustion. Theoretically, it has been calculated that one hundred and fifty cubic feet of air are necessary to consume perfectly one pound of coal in an ordinary furnace, but practically, because of the obstruction of the ashes, which prevents the thorough contact of the air with all parts of the glowing carbon, nearly double this amount is necessary.

Stoves and ranges are now so universally used that it would be needless to multiply illustrations of them. The proper selection of such as are suited to the special uses of the pharmacist must be left to individual decision, and will depend upon the space that can be

spared and the character of the work that is to be done. One important feature should not be overlooked, however, in this connection,—*i.e.*, the addition of a boiler or waterback, whereby a constant supply of hot water can be had. Where stoves are used, this can generally be effected by having a circulating hot water boiler in a convenient corner, the pipes conveying the hot water being heated in the upper part of the combustion chamber of the stove. If sufficient space can be appropriated, a range is very useful, particularly if a sheet iron sliding door can be lowered over the front to enclose the space. Now, when a communicating flue, controlled by a damper, is made to enter the chimney from the top of this space, operations can be conducted here that would otherwise be impossible, noxious vapors being at once carried off by the flue. Fig. 64 represents an ordinary range which is well adapted for many pharmaceutical operations. The front has been removed, in order to show the construction more clearly. This front is of sheet iron, and is hinged to the shelf which supports the boiler; it extends half way over the top of the range, and when the damper is opened, the vapors arising from operations conducted on the top are carried up the chimney. The hot water boiler is connected by pipes with the cold water supply in such a manner that the cold water circulates through pipes which surround the combustion chamber, and, after becoming heated, ascends into the boiler.

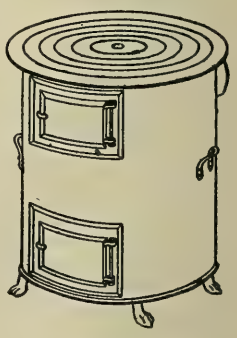
Fig. 64



Pharmaceutical range

Fig. 65 shows a durable pharmaceutical furnace made by Mershon's Sons, which has proved very useful in practical work. The body of the furnace is of wrought iron; it is lined with firebrick, and the top is composed of a series of rings, which permits of the use of various sized kettles, evaporating dishes, etc. It has two cast iron doors, the upper one being especially useful, as it permits the ready feeding of coal to the furnace while a kettle or dish is being heated, without disturbing the latter. Fig. 63 affords a sectional view of the same furnace, and it will be noticed that the combustion chamber, A, is sufficiently deep to contain a considerable body of ignited coal and permit the introduction of hot water pipes. The proportion of the airflue, C, is well arranged, while the vent, B, has sufficient capacity to serve all pharmaceutical purposes.

Fig. 65



Pharmaceutical furnace

The merits of this furnace are that the greater part of the heat rises and is available for heating the vessel placed on the rings, the heavy lining of firebrick preventing lateral radiation to a great extent,

and, while it has all the advantages of a stationary furnace, its position can be changed repeatedly if desired, the relative proportion being so well adjusted that, while it is very sensitive to an increase or decrease of draught, a moderate heat may be as steadily maintained as the intensity of a strong fire.

A drying closet can be adapted to this stove by which the waste heat may be utilized. This will be described in a chapter on Desiccation.

Operations and Forms of Apparatus in which Liquids are used in developing Heat

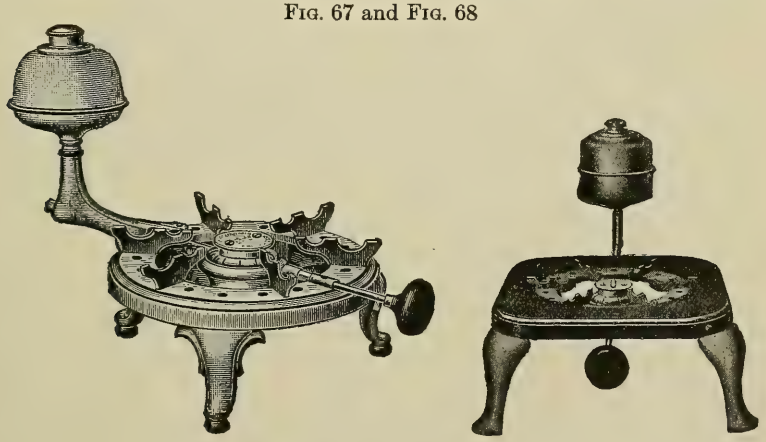
The liquids which are most used in pharmaceutical operations for heating are ethyl alcohol, denatured alcohol, methyl alcohol, petroleum, or coal oil, and petroleum benzin, or gasoline. All of these liquids contain carbon and hydrogen, while alcohol contains 34 per cent. of oxygen in addition.

Fig. 66

Spirit lamp

Alcohol burns with a blue flame, which does not deposit soot, and the heat produced is intense. It is in many respects the best liquid to use for generating heat in small operations, but the expense attending its use in this country is a serious objection, although this has been overcome in part through recent government regulations whereby *ethyl* or *grain* alcohol may be released from bond and sold for technical and industrial purposes if it has been "denatured," that is, rendered unfit for use as a beverage. The "denaturing" must be under the supervision of Internal Revenue officers and the denaturing method used must

Fig. 67 and Fig. 68

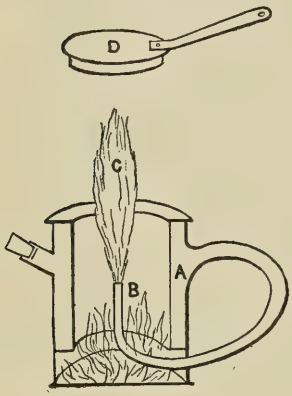


Alcohol Stoves

have the approval of the Internal Revenue Department. Refined *methyl alcohol* or *columbian spirit* has nearly all of the advantages of alcohol when used for burning in lamps, and it is much cheaper than pure ethyl alcohol. It should, however, never be used as a solvent in pharmaceutical preparations, as it is a dangerous liquid when taken internally, and too much caution cannot be exercised to guard against

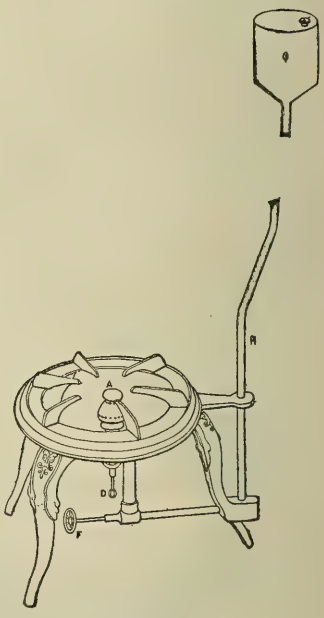
its improper use. In burning alcohol a glass spirit lamp, which is provided with a ground glass cap may be used (see Fig. 66). The cap prevents loss by evaporation of alcohol from the wick, when the lamp is not in use. The older forms of alcohol lamps, such as Berzelius's, Mitchell's, etc., have almost gone out of use, being superseded by improved forms. In one of the simplest of these the alcohol is poured upon brass wire gauze, which covers a metallic box containing asbestos or mineral wool, by which it is absorbed; a lighted match is now applied to the gauze, which retains sufficient spirit to ignite, and a strong heat is at once obtained, the large extent of surface of the gauze producing a solid blue flame. The great advantages of spirit lamps of this kind are that, all parts being of metal, accidents from breakage are avoided, while explosions cannot occur, as neither the

Fig. 69



Russian blast lamp

Fig. 70



Gasoline stove

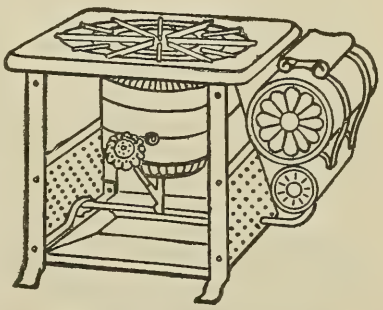
alcohol nor its vapor is confined in a tight receptacle, and if the lamp is upset accidentally no spirit can be spilled, because it is absorbed by the asbestos. Many modifications of this simple contrivance have been introduced which are elaborate and useful. Figs. 67 and 68 show types of alcohol stoves which are extensively used with denatured alcohol. The heated burner vaporizes the alcohol which burns very much like gas and the flame may be readily regulated by turning the knob which operates a needle valve and controls the flow of alcohol.

The so-called Russian blast lamp is one of the best contrivances for generating an intense heat. It is useful when glass tubes of large diameter are to be bent, or in crucible operations. A sectional illustration is seen in Fig. 69. It is made of sheet copper, and consists of a partially jacketed cylinder, A, with an opening on one side for introducing the alcohol, and on the opposite side a bent, tapering tube, B, which pierces the cylinder below the jacketed portion, and is turned upward as shown in the cut. The principle of action is that of the combustion of the *vapor* of the spirit.

Denatured alcohol has also found extensive use as a fuel in the form known as *solidified alcohol.* This is prepared by dissolving 1.35 Gm. of sodium hydroxide in 40 Gm. of alcohol and 8.5 Gm. of stearic acid in 50 Gm. of alcohol, mixing the two solutions, warming until the reaction is complete, and moulding into the desired form.

Petroleum benzin, or *gasoline,* is now used for heating purposes, and Fig. 70 shows one of the most convenient stoves for employing this cheap but very volatile hydrocarbon. The difficulties in the use of the very inflammable and often dangerous liquids of this class for heating have been here largely overcome. To avoid a smoky, luminous flame the *vapor is burned in contact with air,* while to prevent explosions the reservoir for the liquid is elevated and placed four or five feet away from the ignited vapor. When the burner is to be lighted, the valve F is opened slightly, and the valve D turned very carefully, so that a small quantity of gasoline may flow over the sides and collect in the cup. When this is full, both valves, F and D, are turned off, and a lighted match applied to the cup. The burning gasoline will heat the burner A, and when all of the liquid in the cup has been burned and the flame extinguished, the valve D is turned on slightly and a lighted match applied at A. The parts surrounding being hot, the gasoline *is vaporized,* and passing upward through the burner, A, issues through the numerous circular openings and is ignited. The upward current of air caused by the heat mixes with the gasoline vapor and supplies the oxygen necessary to produce a perfectly blue and intensely hot flame, the size of which is regulated by the valves D and F. When fairly ignited, F is slightly opened, and D is used to control the flame by turning to the right or left.

FIG. 71



Wickless blue flame coal oil stove

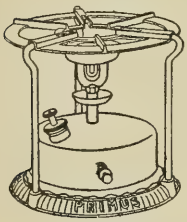
Kerosene, or *coal oil,* is so widely known as a refined petroleum product used for illuminating and heating purposes that any extended notice of its properties in a practical work would be superfluous; as it is heavier in specific gravity and has a much higher flashing point[1] than gasoline, it is much safer for popular use. For many years the only kind of a coal oil stove available for druggists' use were wick-burners. In these, the oil is poured into a reservoir in the base of the stove; the upper part is surrounded with perforated tin, which admits air to the flame and acts as a protection; the wicks, which are flat and wide, have corresponding chimneys, by which the heat is conveyed to the vessel that is to be heated. The disadvantage common to all coal oil stoves using wicks is that the chimneys have to be high enough to secure perfect combustion and prevent smoking, and this removes the vessel that is to be heated so far from the flame that quick heating is almost impossible; in addition to this, the wicks

[1] By this term is meant the temperature at which coal oil begins to give off inflammable vapor which forms an explosive mixture with air. This temperature, fixed by the laws of different states, varies from 43.3° to 65.5° C. (110° to 150° F.).

require constant attention, and imperfect combustion frequently results even when care is exercised.

The introduction of the "wickless blue flame oil stove" marked an era in practical methods of generating heat. Fig. 71 shows a good form. The stove must stand upon a level surface, for if it does not the coal oil will not flow properly. The cylindrical reservoirs on the side are supplied with an automatic feeder, whereby a uniform quantity of oil is furnished to the burner. The principle upon which this kind of a stove operates is that of *burning the vapor* of the oil (see gasoline stove, Fig. 70), and the control becomes an important factor. A lighting ring containing asbestos is first saturated with oil by turning one of the valves, and when a lighted match is applied sufficient heat is soon generated to cause the coal oil to burn with a blue flame without smoke or odor. Fig. 72 shows a smaller wickless coal oil stove which is very efficient.

Fig. 72



Wickless blue flame coal oil stove

Operations and Forms of Apparatus in which Gases are used in developing Heat

Gas.—The extensive employment of manufactured illuminating gas and the growing use of natural gas as sources of heat for pharmaceutical and other purposes render necessary a somewhat extended notice of gas in this connection. Illuminating gas was frequently called carburetted hydrogen, but it is really a mechanical mixture of various gases, some of which produce luminous flames and others do not; besides the hydrocarbon, CH_4 (carburetted hydrogen), which is the principal constituent, it contains condensible hydrocarbons, hydrogen, carbon dioxide, carbon monoxide, aqueous vapor, and traces of oxygen and nitrogen. Gas is usually produced by the destructive distillation of gas coal, while coal tar, gas liquor, and coke are the liquid and solid by-products, and these are now exceedingly useful as the sources of valuable manufactures in the arts. Gas which is fitted for illuminating purposes must have its composition modified by admixture with air before it is fit for heating purposes; this may be best illustrated by the examination of an ordinary fishtail gas flame. In Fig. 73 it will be noticed that three zones are visible,—the lower or dark central zone, which is not luminous and not at all hot, because the gas is not fairly ignited; A, the luminous zone, where the emission of light is due to the suspension of minute particles of incandescent carbon in the flame, caused by the incomplete combustion of the gas; and the outer non-luminous zone, or "mantle" which fringes the flame, and where the particles of carbon coming in direct contact with the air are entirely consumed, the commonly accepted theory being that the oxygen in the air unites chemically with the incandescent carbon particles, producing the invisible gases carbon monoxide and carbon dioxide.

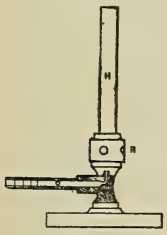
Fig. 73

Gas flame

Soon after gas came into use it was discovered that the properties which rendered it most valuable as an illuminator prevented its use as a source of heat, because of the deposition of the particles of soot from the luminous portion of the flame upon vessels that were to be heated. Dr. Duncan, of Edinburgh, showed that if gas properly mixed with air was made to enter at the bottom of a tall tinned iron cylinder, the upper end of which was covered with wire gauze, it would burn when ignited above the gauze with a blue, smokeless flame. The unnecessarily long cylinders (sometimes thirty inches) which were originally used were soon replaced by others of the length of five or six inches, for the sake of greater convenience. This discovery was at once utilized, and gas stoves and burners for various purposes came into use immediately.

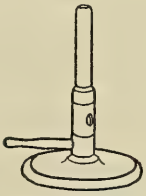
Bunsen burners are more frequently used in simple operations than any other form (see Fig 74). The coal gas issues from a small orifice, O, near the base, passes up through a brass tube, H, four inches high, and is ignited at the top of this tube; four large circular openings surround the small orifice at the base, and these may be closed either

Fig. 74



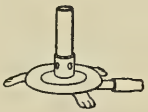
Bunsen burner

Fig. 75



Bunsen burner (Morton's)

Fig. 76



Short burner

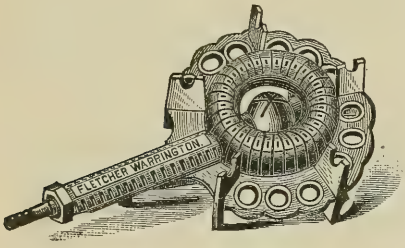
Fig. 77

Short burner with support

wholly or in part by a perforated brass ring, R; this permits the regulation of the supply of air, which mixes with the gas as it ascends the tube, and a blue, smokeless, intensely hot flame may be produced; if the perforated ring is turned so that the air openings are closed, a luminous, smoky flame results. One of the objections to the ordinary Bunsen burner is that, after being used for a time under a low gas pressure, when the tube becomes hot the flame will sometimes recede and the gas become ignited at the lower orifice. This may usually be avoided by gradually turning the brass perforated ring, so as to admit less air to suit the diminished pressure. Morton corrected this receding of the flame by contracting the orifice of escape at the top to about two-thirds of the area of the tube. That the length of the perpendicular tube does not materially affect the smokeless character of the flame may be proved by the use of the convenient little burners shown in Figs. 76 and 77. These are made by the Buffalo Dental Manufacturing Company, and have proved very useful at the prescription counter. Bunsen burners with the tube arranged horizontally have grown in favor because they are less likely to be overturned, and if they have a broad base they will easily support a large vessel. Fletcher's radial burner (see Fig. 78) has the merit of having no loose parts, and, as the casting is well annealed, it is well adapted for

rough usage, the gas issuing from narrow slits cut radially in the raised circular burner; the flame is solid and non-luminous. No gauze is needed to distribute the heat. In Fig. 79 is shown a very compact and useful gas burner, well adapted for the dispensing counter, it is of the horizontal Bunsen type, and is furnished with an attachment for distributing the flame, and three short legs for supporting the vessel that is to be heated.

Fig. 78



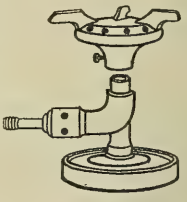
Fletcher's radial burner

In many localities outside of cities and towns, gas made by vaporizing gasoline and mixing air with it is used for illuminating purposes. It is made by gas machines, as they are termed, the air pump, operated by weights and pulleys or by a water wheel, being usually located in the cellar of the residence or building, while the gasometer is buried underground at a safe distance. This gas is very satisfactory, but it has been only within a few years that it has been utilized for heating purposes. Special burners are required when this gas is used as an illuminant, and they require some adjustment at first to secure the proper proportion of air. Fig. 80 shows the Springfield laboratory burner, which gives a very hot, blue flame with this kind of gas, and it may also be used with ordinary gas. The milled head at the base of the burner is used to control the quantity of the gas passing through, while by revolving the burner itself upon the thread of the screw by which it is connected with the base, the quality of the gas is determined,—*i.e.*, the proper proportion of air is admitted.

Fig. 80

Springfield laboratory burner

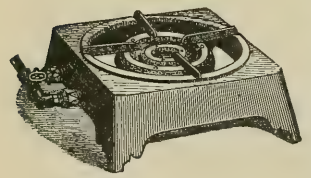
Fig. 79



Horizontal Bunsen burner

Gas stoves are now made in such variety that it seems difficult to make a judicious selection for general pharmaceutical work. The error most frequently made is in the choice of those which are intended to produce only very high temperatures. It is very seldom that a heat of great intensity is desired in pharmaceutical operations. The chief points to be secured in a good gas stove are—1, a smokeless flame; 2, a strong, firm, indestructible frame that will easily support a large or small vessel and is not easily overturned; 3, an easy and quick adjustment, whereby either a strong, well sustained heat or a low, diffused heat may be obtained. Prof. Parrish devised a pharmaceutical stove which had these qualifications, but it is not made at present. Fig. 81 shows one which is known in commerce as the Economy gas stove. It is made by the American Meter Company, and of all of the gas stoves that have been used by the author, this is the

Fig. 81

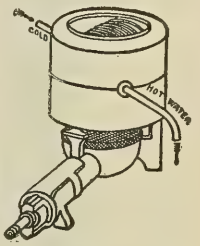


Economy gas stove

one which is in every way most suited for pharmaceutical operations. It has a broad, low, strong base, and cannot be easily overturned, and a double ring burner, so arranged that either the small ring or both the small and large rings may be used. As it is only about four inches high, the contents of a vessel placed upon it may be conveniently stirred. It is nine inches square, and its consumption of gas when both rings are lighted is about ten feet per hour.

One of the greatest conveniences that a pharmacist can have at a dispensing counter, where a large supply of hot water cannot be had from a boiler, is the water heater shown in Fig. 82. If hot water is desired, the pipe at the top is connected with a hydrant, the water turned on, and the gas burner lighted below; in a few seconds warm water, and in a minute or two hot water, will run from the lower pipe. Many kinds of hot water apparatus are now to be had based on this principle. Fig. 83 shows a convenient hot water generator, well adapted for furnishing a supply of hot water in pharmacies which have not access to the waterback of a range, but can use gas. In the illustration it is shown attached to an ordinary circulating boiler, and it can be depended upon to furnish a large quantity of warm water. It is made by the United Gas Improvement Company of Philadelphia, but similar water heaters are supplied by all gas companies.

Fig. 82



Water heater

The advantages of the use of illuminating gas as a source of heat may be summed up as follows: 1. It may be made to furnish a clean, smokeless flame. 2. It is cheap when compared with alcohol and other sources of heat, and is particularly economical in large cities. 3. The supply is unremitting, and the inconvenience of continually supplying fuel, which is always present in other forms of stoves, is not experienced here. 4. The supply is under almost perfect control, and, after once regulating the flow suitable for a continuous operation, little apprehension need be felt, during the operator's enforced absence, of an injurious rise or fall in the temperature.

Operations and Forms of Apparatus in which Electricity is used in developing Heat

Electricity as a Source of Heat.—The enormous use of electricity as a source of light has naturally turned the minds of inventors to devising means of using it for heating purposes. Unless, however, the current is abundant, as when developed by a water power plant, it cannot be used economically by the pharmacist, and, if illuminating gas is available, electric heating on a large scale is unprofitable. In many city stores lighted by electricity it will often be found that for convenience, cleanliness, and ease of application electrical stoves have an advantage. Fig. 84a shows a simple electrical stove which can be used for small operations. The current flows through fine wires of highly resisting metal embedded in fireproof insulating cement in the base, and the heat produced by the resistance warms the top plate of the stove. Fig. 84 illustrates another form of electric stove, made by the Hughes

Electric Heating Co., in which the heat is produced by exposed wires which become red hot through the resistance they offer to an electric current passing through them. The heat may be regulated to "high," "medium," or "low," or may be turned off completely through the use of a switch operated by a button. The several degrees of heat burn 880, 440, or 220 watts, respectively, of electric current, per hour.

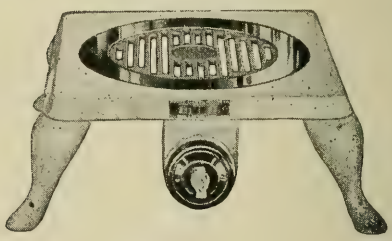
FIG. 83

Hot water heater

Many other forms of electrically heated stoves are now available for heating ovens, sterilizers, jacketed kettles, general cooking purposes, etc.

In certain industries electricity has been largely used as a source of heat, especially for high temperatures, or where a flame would be dangerous.

FIG. 84

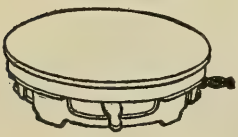


Electric stove

Methods of Measuring Heat

To measure degrees of temperature in pharmaceutical operations thermometers are used exclusively. A thermometer may be described as an instrument consisting of a glass tube having a capillary bore, with a cylindrical or globular bulb blown at the end, the bulb and a part of the stem containing a liquid (usually mercury), and the tube being mounted upon a graduated scale, or the tube itself graduated, in order to measure the degree of expansion of the liquid when subjected to the influence of heat. Unfortunately, the value of the degrees of thermometers in common use is not the same, there being no less than three arbitrary scales,—Centigrade, Fahrenheit, and Réaumur, the latter rarely used in English speaking countries.

FIG. 84a

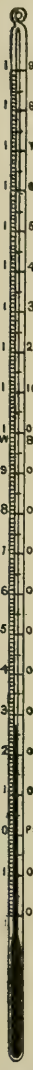


Electric stove

The *Centigrade*, or Celsius, scale is best adapted for scientific work; it is given the first place in the U. S. P. (9th Rev.). The freezing point of water on this scale is zero, 0°, and the boiling point is 100°; the intervening space is divided into one hundred equal parts (see Fig. 85), and thus the system of decimal division, now so largely used in coinage and in weights and measures, is maintained for temperature. Most of the foreign literature, especially French and German, use the Centigrade scale.

The *Fahrenheit* scale is much the most largely used in this country and Great Britain, and until the 1880 revision of the U. S. Pharmacopœia it was used exclusively in pharmacy. In this book the Centigrade degrees of the Pharmacopœia are followed by those of Fahrenheit enclosed in parentheses, as 100° C. (212° F.). In Fahrenheit's thermometer the freezing point is 32°, and the boiling point is 212°, the intervening space being divided into one hundred and eighty equal parts (see Fig. 86). In Réaumur's thermometer the freezing point is 0°, and the boiling point is 80°.

Fig. 85



Centigrade thermometer

Fig. 86

Fahrenheit thermometer

Fig. 87

Paper scale thermometer

Fig. 87 shows a convenient and cheap form of thermometer for pharmaceutical uses, but on account of its having a paper scale it should not be used for measuring temperatures above 300° F. as the paper will be charred.

In Figs. 88, 89, and 90 the three thermometers are shown together to facilitate comparison. The lowest figures indicate the freezing points of each, the highest the boiling points.

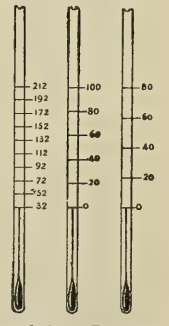
RULES

1. *To convert Centigrade degrees into those of Fahrenheit*, multiply by 1.8 and add 32.

2. *To convert Fahrenheit degrees into those of Centigrade*, subtract 32 and divide by 1.8.

Choice of Thermometers.—It is important that the practical pharmacist should possess a good thermometer. The best form is one in which the graduations are made on the surface of the tube. The diameter of the instrument should be the same throughout its entire length; this permits its convenient use through perforated corks in distillations and other operations where it is necessary to observe temperature, and it is not so easily broken (see Fig. 85). The thickness of the glass of the bulb is not a matter of indifference. If too thick, the thermometer will not respond quickly to changes of temperature, while if too thin, the risk of fracture is very great. The bore of the tube should be flat or elliptical, and perfectly uniform throughout. The absence of air in the tube may be known by the descent of the mercury to the lowest

Fig. 88 Fig. 89 Fig. 90



Fahrenheit Réaumur Centigrade

part of the tube when the thermometer is inverted. A strip of opaque, white enamelled glass behind the bore of the tube is of great assistance in reading the indication quickly. It is a good practice to send a thermometer to be officially tested,[1] and then to reserve it as a standard for correcting ordinary instruments. As glass usually reaches its limit of contraction in three years, such a thermometer should be at least this old before it is sent.

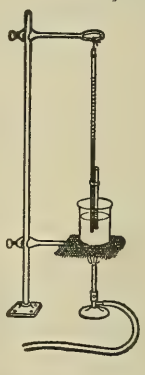
Fig. 91

Clinical thermometer

Fig. 91 illustrates one of the most valuable forms of the thermometer; it is called a *clinical* thermometer. The glass is triangular instead of cylindrical, and the capillary orifice is flattened so as to enlarge the diameter of the surface of the mercury, in order that it can be read easily. The normal temperature of the human body is 98.5° F., and the physician, by inserting the bulb of the thermometer under the patient's tongue and allowing it to rest there for a minute, can easily ascertain the presence or absence of symptoms of fever.

The following specifications for thermometers for official tests have been established by the U. S. P. IX:

Fig. 92



Taking the melting point

Fig. 93a Fig. 93b

Bensemann's method of collecting fusible body

U. S. P. IX Standard Thermometers

General Requirements.— The bulbs are to be of Jena 16 III normal glass or Corning normal thermometer glass. The stems may be made of other white enamel back glass tubing having a circular cross section; the diameter of the capillary must not be greater than 0.1 mm. The diameter of the stem is to be 5.5 mm. (to within ± 0.3 mm.), and the maximum diameter of the bulb must not be greater than the diameter of the stem. The thermometers are to have a pear-shaped reservoir at the upper end of the capillary having a volume at least equal to the volume of the entire graduated portion of the stem. The upper end of the stem is to have a small glass ring.

Graduation.—The thermometers are all to be graduated into 0.5° (one-half degree) intervals. The 1° graduation marks are to be longer than those for the half degrees, the longer graduations extending, preferably, equally to the right and left of the shorter marks. The graduation marks are to be clean cut and fine, and to be uniformly well-filled with insoluble colored pigment.

Numbering.—The 100° graduations (the 0°, 100°, 200°, 300° graduations on the different thermometers) are to be numbered in full and the intermediate 5° and 10° graduations are to be numbered 5, 10, 15, etc. . . . 95, 100, 5, 10, 15, . . . 95, 200, 5, 10, etc. The numbers must be distinct and easily legible and preferably in such position that

[1] Clinical Thermometers are examined, and certificates are issued showing the corrections, by Winchester Observatory, of Yale College, New Haven, Conn., and by many others.

they will be upright when the thermometer is vertical. The figures should not be unduly large. It is suggested that the figures opposite the 0°, 100°, 200°, 300° graduations be made about 2 mm. in height and the intermediate numbers of 5, 10, 15, etc., somewhat less (about 1.4 mm.).

Annealing.—The thermometers should be so thoroughly annealed that there will be no appreciable change in their indications after long continued exposure to the highest temperature on the scale.

Error of Scale.—The maximum error at any temperature below 100° C. must not exceed 0.5°, nor exceed 1.0° in the interval 100° to 350°C.

Standardization.—The thermometers should be submitted to the Bureau of Standards for standardization or carefully compared with thermometers actually standardized by the Bureau of Standards.

Filling Under Pressure.—Thermometers reading over 200° C. must be filled under sufficient pressure to prevent the mercury column from boiling or breaking up into small pieces.

Thermometer No. 1.—The thermometer is to be graduated from—10.5° to 125.5° C. into half degrees, the length of a 1° interval being 1.5 to 2 mm.

Thermometer No. 2.—The thermometer is to be graduated from 98° to 225.5° C. into half degrees, the length of a 1° interval being 1.5 to 2 mm. The graduations to begin a short distance above top of bulb so that the distance from first graduation (98°) to bottom end of bulb shall be not over 40 mm.

Thermometer No. 2A.—The thermometer is to be graduated into half degrees in the neighborhood of ice point from 1° to 2°, above which is to be a small enlargement in the capillary, and then a graduated portion extending from 98° to 250.5° C., the length of a 1° interval being 1.5 to 2 mm. The length of the thermometer between the 98° mark and the lower end of the main bulb should not exceed 65 mm.

Thermometer No. 3.—The thermometer is to be graduated from 198° to 350.5° C. into half degrees, the length of a 1° interval being 1.5 to 2 mm. The graduations to begin a short distance above the top of the bulb so that the distance from the first graduation (198°) to the bottom end of the bulb shall be not over 40 mm. The graduated stem to be the same length as Nos. 1 and 2.

Thermometer No. 3A.—The thermometer is to be graduated into half degrees in the neighborhood of the ice point from—1° to 4°, above which is to be a small enlargement in the capillary, and then a graduated portion extending from 198° to 350.5° C., the length of a 1° interval being 1.5 to 2 mm. The length of the thermometer between the 198° mark and the lower end of the main bulb should not exceed 65 mm.

Auxiliary Thermometer.—This thermometer is for emergent stem corrections. Use a standard thermometer from 15 to 20 cm. in length and graduated from 20° to 100° C., into degrees.

Thermometers for Boiling Points.—In order to avoid the necessity of an emergent stem correction, it is advisable that an accurately standardized thermometer of the Anschütz type be used for boiling points. If such a thermometer is not available, a thermometer such as is specified above (see No. 1, 2, or 3) may be employed, applying the emergent stem correction as described under *Melting Points* (see page 130), the length of emergent stem being measured, in degrees, from the lower end of the stopper to the highest point of the boiling temperature.

Melting Point.—By this is meant the temperature at which a substance melts or fuses. It is used as a means of identifying a body or of proving its purity. The U. S. P. IX cites the melting point of many bodies and has established the following official method for their determination. Melting points may also be taken with an apparatus like that shown in Fig. 92. The melted substance is drawn into the small tube and allowed to cool, or the end of the tube is sealed. The tube is attached by a rubber band to a thermometer, and both immersed in a bath of some convenient liquid. The whole is gradually heated, and the point at which the substance melts is noted. Figs. 93a and 93b show Bensemann's method of collecting a fusible body by holding the tube horizontally until the melted body cools. When heated carefully the exact point at which it melts can be seen by the liquid flowing down the side.

U. S. P. IX Method for Determining Melting Points

For the purpose of the Pharmacopœia the melting point is defined as that interval of temperature within which the substance is observed to melt when treated as directed below.

For the determination of the melting point, Pharmacopœial substances are divided into two classes:

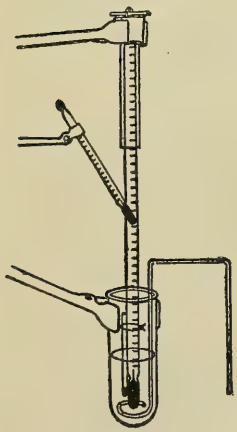
Class I.—Substances readily reduced to a powder.

Class II.—Substances not readily reduced to a powder, such as fats, fat acids, paraffin, petrolatum and waxes.

Apparatus required (see Fig. 94):

1. *A round-bottom, glass tube* of 30 mm. internal diameter and about 10 cm. long, flaring slightly at the top like an ordinary test tube. The walls of the tube are not more than 1.5 mm. thick at any point. The tube is made of glass which will stand heating over an open Bunsen flame.

FIG. 94



Apparatus for taking melting points

2. *A stirring device*, which can be made from a glass rod of about 2 mm. external diameter. It is made circular at the end to fit the container (1) and is bent twice at right angles above the top of the container to bring its outer end conveniently to hand for manipulation.

3. *A standard thermometer* covering the desired range of temperature (see page 128).

4. *An auxiliary thermometer* (see page 129).

5. *A capillary glass tube* about 6 cm. long and from 0.8 to 1.2 mm. internal diameter, 0.2 to 0.3 mm. thick and the tube closed at one end.

Procedure for Class I: Reduce the substance to a No. 100 powder and, unless otherwise stated, render it anhydrous, when it contains water of crystallization, by drying it at the temperature given in the text, or, when the substance contains no water of crystallization, by drying it for twenty-four hours over sulphuric acid.

Select a bath suitable for the melting temperature to be determined, and fill the container to a depth which will permit of such immersion of the thermometer that the upper end of

the bulb will be from 2 to 3 cm. below the surface of the bath and the lower end of the bulb about equally distant from the bottom of the container.

Charge a capillary glass tube with sufficient of the dry powder to form a column in the bottom of the tube from 2.5 to 3.5 mm. high when packed down as closely as possible by moderate tapping on a solid surface. Attach the capillary tube to the thermometer by wetting both with the liquid of the bath or by means of a piece of platinum wire and adjust it so that the substance is centrally located by the side of the thermometer bulb. Heat the bath by means of a free Bunsen flame until a temperature 25° C. below the supposed melting point is reached, then carefully regulate the rate of rise in temperature to about 3° per minute until the substance begins to melt (the temperature at which the column of the substance is observed to definitely collapse against the sides of the tube at any point is defined as the beginning of melting), and from that time carefully regulate the rise in temperature to about 0.5° per minute until melting is complete (the temperature at which the substance becomes liquid throughout is defined as the end of melting). The bath must be stirred constantly throughout the heating.

The result thus obtained as the melting interval must be adjusted by applying the calibration correction and that for the emergent stem, as follows:

Attach the auxiliary thermometer, as shown in the illustration, so that the center of its bulb is as close as possible to the stem of the main thermometer at a point midway between the surface of the bath and the supposed melting point. In order to prevent the heat from the burner or currents of cold air from affecting the temperature of the auxiliary thermometer, it is advisable to adjust to the stem of the main thermometer a movable platform made of stiff paper, having its edges folded so as to form a box-like shield surrounding the bulb of the auxiliary thermometer. Note the temperature registered by the auxiliary thermometer at the end of the melting of the substance and calculate the emergent stem correction by the following formula:

$$\text{correction} = 0.00015 \times N\ (T-t)$$

in which N represents the number of degrees of emergent stem from the bath, T the temperature at the end of melting, and t the temperature registered by the auxiliary thermometer; the correction to be added to the observed reading of the main thermometer.

To avoid the necessity of determining the emergent stem correction each time a melting point is taken, the corrections for intervals of 10° C. may be determined (at about 25° C. room temperature) and the results plotted on cross-section paper, the temperature of the bath represented by the abscissæ and the amount of correction by the ordinates. The correction for any intermediate temperature can then be interpolated.

NOTE: Suggestions regarding liquids to be used for baths in Class I:

For temperatures up to 200° C. a purified, concentrated sulphuric acid is a suitable bath. For higher temperatures, up to about 350° C., a pure grade of cotton seed oil (almost colorless) will serve for a limited number of determinations. Other, though less desirable, substitutes

for sulphuric acid at high temperatures are: (1) a pure grade of paraffin which has been freshly distilled; (2) clean, white, artificial (cotton seed) lard. A very desirable bath for high temperature work is prepared by cautiously boiling together, for five to ten minutes under a hood, a mixture of 70 parts of purified concentrated sulphuric acid and 30 parts of potassium sulphate, stirring constantly until the sulphate is completely dissolved.

Procedure for Class II: Carefully melt the substance to be tested at as low a temperature as possible and draw it into a capillary tube which is open at both ends, to a depth of about 10 mm. Cool the charged tube at 10° C., or lower, for twenty-four hours, or in contact with ice for at least two hours. Then attach the tube to a standard thermometer by means of a rubber band, adjust and heat it in a water bath, as directed in Class I, except that, within 5° of the assumed melting temperature, the rate of rise of temperature is carefully regulated at about 0.5° per minute.

The temperature at which the substance is observed to rise in the capillary tube is taken as the melting point. Melting points may also be taken with an apparatus like that shown in Fig. 92. The melted substance is drawn into a small tube and allowed to cool, or the end of the tube is sealed. The tube is attached by a rubber band to a thermometer, and both immersed in a bath of some convenient liquid. The whole is gradually heated, and the point at which the substance melts is noted. Figs. 93a and 93b show Bensemann's method of collecting a fusible body by holding the tube horizontally until the melted body cools. When heated carefully the exact point at which it melts can be seen by the liquid flowing down the side.

Table of Melting Points of Official Substances

Guaiacol (solid)	about	28° C.	= 82.4° F.
Oleum Theobromatis		30°–35° C.	= 86°–95° F.
Ferri Chloridum	about	35.5° C.	= 96° F.
Adeps		36°–42° C.	= 96.8°–107.6° F.
Adeps Lanæ		38°–42° C.	= 100.4°–107.6° F.
Petrolatum		38°–54° C.	= 100.4°–129.2° F.
Petrolatum Album		38°–54° C.	= 100.4°–129.2° F.
Sodii Phosphas	about	40° C.	= 104° F.
Phenylis Salicylas		41°–43° C.	= 105.8°–109.4° F.
Cetaceum		42°–50° C.	= 107.6°–122° F.
Menthol		42°–44° C.	= 107.6°–111.2° F.
Phosphorus	about	44° C.	= 111.2° F.
Sevum Præparatum		45°–50° C.	= 113°–122° F.
Æthylis Carbamas		48°–50° C.	= 118.4°–122° F
Thymol		48°–51° C.	= 118.4°–123.8° F.
Paraffinum		50°–57° C.	= 122°–134.6° F.
Acidum Stearicum not below		56° C.	= 132.8° F.
Sodii Acetas	about	58° C.	= 136.4° F.
Sodii Cacodylas	about	60° C.	= 140° F.
Cera Alba		62°–65° C.	= 143.6°–149° F.
Cera Flava		62°–65° C.	= 143.6°–149° F.
Potassii et Sodii Tartras	about	74° C.	= 165.2° F.
Camphora Monobromata		74°–76° C.	= 165.2°–168.8° F.
Sulphonethylmethanum		74°–76° C.	= 165.2°–168.8° F.
Plumbi Acetas		75° C.	= 167° F.
Vanillinum		80°–82° C.	= 176°–179.6° F.

Guaiacolis Carbonas	83°–87° C.	=	181.4°–188.6° F.
Cocaina	96°–98° C.	=	204.8°–208.4° F.
Resorcinol	109°–111° C.	=	228.2°–231.8° F.
Antipyrina	111°–113° C.	=	231.8°–235.4° F.
Acetanilidum	112°–114° C.	=	233.6°–237.2° F.
Iodum	about 114° C.	=	237.2° F.
Atropina	114°–116° C.	=	237.2°–240.8° F.
Sulphur Lotum	about 115° C.	=	239° F.
Sulphur Præcipitatum	about 115° C.	=	239° F.
Sulphur Sublimatum	about 115° C.	=	239° F.
Zinci Chloridum	115° C.	=	239° F.
Terpini Hydras	115°–117° C.	=	239°–242.6° F.
Acidum Benzoicum	120°–122° C.	=	248°–251.6° F.
Betanaphthol	120°–122° C.	=	248°–251.6° F.
Æthylmorphinæ Hydrochloridum	about 123° C.	=	253.4° F.
Trinitrophenol	121°–123° C.	=	249.8°–253.4° F.
Sulphonmethanum	124°–126° C.	=	255.2°–258.8° F.
Pyrogallol	129°–133° C.	=	264.2°–271.4° F.
Hydrastina	about 131° C.	=	267.8° F.
Pyrogallol	129°–133° C.	=	264.2°–271.4° F.
Acetphenetidinum	133°–135° C.	=	271.4°–275° F.
Colchicina	142°–146° C.	=	287.6°–294.8° F.
Hyoscyaminæ Hydrobromidum	about 152° C.	=	305.6° F.
Codeina (anhydrous)	154°–156° C.	=	309.2°–312.8° F.
Acidum Salicylicum	156°–159° C.	=	312.8°–318.2° F.
Acidum Boricum	about 160° C.	=	320° F.
Santoninum	169°–171° C.	=	336.2°–339.8° F.
Pilocarpinæ Nitras	170°–173° C.	=	338°–343.4° F.
Diacetylmorphina	171.5°–173.5° C.	=	340.7°–344.3° F.
Camphora	174°–177° C.	=	345.2°–350.6° F.
Cocainæ Hydrochloricum	183°–191° C.	=	361.4°–375.8° F.
Atropinæ Sulphas	188°–191° C.	=	370.4°–375.8° F.
Scopolaminæ Hydrobromidum (anhydrous)	190°–192° C.	=	374°–377.6° F.
Chromii Trioxidum	about 193° C.	=	379.4° F.
Aconitina	about 195° C.	=	383° F.
Pilocarpinæ Hydrochloridum	195°–198° C.	=	383°–388.4° F.
Salicinum	198°–202° C.	=	388.4°–395.6° F.
Argenti Nitras	200° C.	=	392° F.
Arseni Trioxidum (amorphous variety)	200° C.	=	392° F.
Cinchonidinæ Sulphas (anhydrous)	about 200° C.	=	392° F.
Acidum Phenylcinchoninicum	about 210° C.	=	410° F.
Hydrastininæ Hydrochloridum	about 210° C.	=	410° F.
Homatropinæ Hydrobromidum	about 212° C.	=	413.6° F.
Benzosulphinidum	219°–222° C.	=	426.2°–431.6° F.
Diacetylmorphinæ Hydrochloridum	about 230° C.	=	446° F.
Caffeina (anhydrous)	235°–237° C.	=	455°–458.6° F.
Phenolphthaleinum	not below 253° C.	=	487.4° F.
Hydrargyri Chloridum Corrosivum	265° C.	=	509° F.
Theophyllina	269°–272° C.	=	516.2°–521.6° F.
Zincum	412°–415° C.	=	773.6°–779° F.

Congealing Point.—This physical factor is of value mainly in determining the purity of certain volatile oils and is dependent upon the presence of constituents which crystallize when cooled to the temperature indicated, known as the "congealing point." The official method follows:

U. S. P. IX Method for Determining Congealing Points

Unless otherwise directed, about 10 mils of the liquid to be tested is introduced into a dry test tube of from 18 to 20 mm. internal diameter, which is then cooled in water or a suitable freezing mixture, the temperature of which should be about 5° lower than the supposed congeal-

ing point of the liquid. To induce crystallization, rub the walls of the tube with a standard thermometer (see page 128), or add a small crystal of the substance being tested. By alternated immersion of the tube in the bath, or removal from the bath and constant stirring with the thermometer, the temperature is so adjusted that the greater part of the liquid gradually congeals. The highest temperature remaining constant for a short time during the congealing is defined as the congealing point.

QUESTIONS ON OPERATIONS REQUIRING THE USE OF HEAT

According to the dynamical theory, how is heat produced? (See page 116.)
What solids are commonly used as fuels in developing heat?
What is the objection to using wood as a source of heat in pharmaceutical operations?
Is charcoal more or less convenient, and why?
What advantages has anthracite coal?
What is the objection to bituminous coal?
What are the advantages of coke as a fuel?
What fundamental parts constitute a furnace?
What percentage of carbon is present in anthracite coal?
What gases are produced by the combustion of coal?
How much air is required for the burning of one pound of coal?
Describe the construction of a range with waterback and tell its advantages.
What liquids are used for heating purposes in pharmaceutical operations?
What objection is there to the use of alcohol?
Describe a simple alcohol stove.
What is denatured alcohol? What are its advantages over ordinary grain alcohol?
To what uses may methyl alcohol be put?
Describe several styles of alcohol stoves which are useful and practicable.
What is the arrangement of the so-called Russian blast lamp?
How may petroleum benzin or gasoline be burned without danger from explosion?
Is kerosene or coal oil safer as a fuel than gasoline? If so, why?
Does coal oil require a wick to burn satisfactorily?
What is the disadvantage of using a wick?
Describe the blue flame, wickless coal oil stove.
Upon what principle is this stove constructed?
Of what does ordinary illuminating gas consist? How is it produced?
What valuable liquid and solid by-products are obtained in process of manufacture?
Give an explanation of the three zones that are apparent in an ordinary gas-flame.
How may ordinary gas be burned so as to become a source of heat rather than of light?
What is a Bunsen burner?
What is the objection to the ordinary Bunsen burners?
How may this be obviated?
How does the length of the perpendicular tube affect the smokeless character of the flame?
Describe Fletcher's radial burner?
How may the vapor of gasoline be used in place of gas?
What are the chief points to be secured in a good gas stove?
Describe the Economy gas stove.
What are the chief advantages in this stove?
Describe an instantaneous water heater for use at the prescription counter.
What are the advantages of the use of illuminating gas as a source of heat?
How may electricity be used as a source of heat?
In pharmaceutical operations, how are degrees of temperature measured?
What is a thermometer?
What three scales of degrees of heat for thermometers are used?
Which is most largely used in this country?
Which is used in the U. S. P.?
What are the freezing and boiling points of Fahrenheit's scale?
How is the intervening space divided?

What are the freezing and boiling points of the Centigrade scale?
How is the intervening space divided?
What are the freezing and boiling points of Réaumur's scale?
How is the intervening space divided?
How may Centigrade degrees be converted into those of Fahrenheit above 32?
How may Fahrenheit degrees above 32 be converted into Centigrade degrees?
What are the essential points of a good thermometer?

Convert—13.72° C. into F.

Illustration

$$\begin{array}{r} -13.72 \\ 1.8 \\ \hline 10976 \\ 1372 \\ \hline -24.696 \\ +32 \\ \hline 8.696 \end{array}$$

Convert—27.4° F. into C.

Illustration

$$\begin{array}{r} -27.4 \\ -32 \\ \hline 1.8)-59.4(-33 \\ 54 \\ \hline 54 \\ 54 \\ \hline \end{array}$$

Convert—5° C. into F.

Convert—2.2° F. into C.

Convert 78° C. into F.

Convert 62° F. into C.

What is a clinical thermometer?
Give the normal temperature for the human body.
What are the general specifications established for thermometers by the U. S. P. IX?
How many kinds of thermometers are recognized? Describe each.
What is meant by a melting point and of what value is such a factor?
Describe the ordinary method of taking a melting point; also Bensemann's method.
Describe the U. S. P. IX method for substances listed under Class I. For substances under Class II.
What is meant by a congealing point and what is its value?
Describe the U. S. P. IX method for its determination.

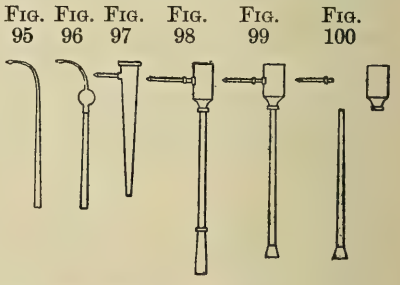
CHAPTER III

USES OF HEAT

THE consideration of the uses of heat in pharmacy will follow naturally the preceding chapter upon its generation and measurement, and the subject may be properly treated of under two classes,—viz., 1, those operations in which comparatively high temperatures are required, and, 2, those which require moderate or low temperatures. It will be readily noticed that the latter class will embrace nearly all of the more important pharmaceutical operations in which heat is employed.

Operations in which comparatively High Temperatures are required.—In this class of operations must be placed some which seem to be in danger of becoming lost arts through the growth of special methods, which are now conducted on a large scale by manufacturers, who supply the products of their skill so cheaply that the home made apparatus is often produced at a pecuniary loss. It will, nevertheless, be found useful to refer briefly to these operations, for a certain amount of knowledge will frequently be of service to the practical worker in emergencies and on special occasions.

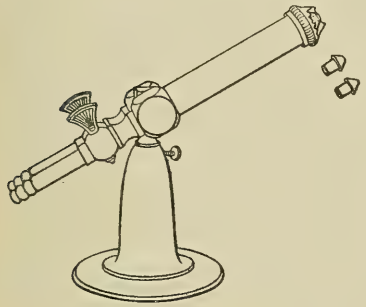
The Use of the Blowpipe.—A blowpipe in its simplest form is a metallic tube, usually of brass or copper, slightly conical, gradually tapering to a minute orifice, the narrowest portion being curved so that the axis of the orifice is at right angles to that of the principal portion of the tube. It is used by placing the widest end in the mouth, and inserting the other end into the edge of the flame, and forcing a current of air through the tube, with the effect of increasing the intensity of the flame by converting it into a miniature blast. Some skill and practice are required to produce an unremitting current of air, and this is effected by keeping the muscles of the cheeks distended and constantly supplying air from the lungs as it is needed. When the blowpipe is used with a luminous flame, the interior of the flame, owing to the carbon not being wholly oxidized, has the power of deoxidizing or reducing oxides, while the outer flame has opposite or oxidizing properties. A piece of lead glass tube held in the inner flame will be blackened through the reduction of the lead oxide to the metallic state; if this stain is held in the outer flame the metal is reoxidized, dissolves in the glass, and the glass again becomes transparent. The blowpipe is



useful in pharmacy in working and bending glass, in testing fusible chemical substances, in soldering apparatus, etc. The various forms of blowpipes in common use are shown in Figs. 95 to 100.

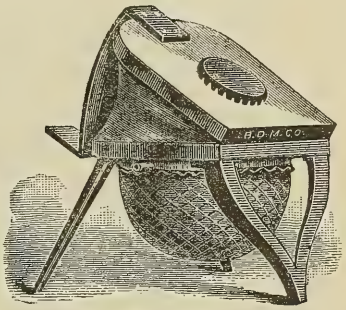
The gas blowpipe, shown in Fig. 101, furnishes an excellent and very powerful blast which is capable of delicate adjustment. It has a universal ball and socket joint, which enables it to be used in any position. The very convenient foot bellows, shown in Fig. 102, may

Fig. 101



Gas blowpipe

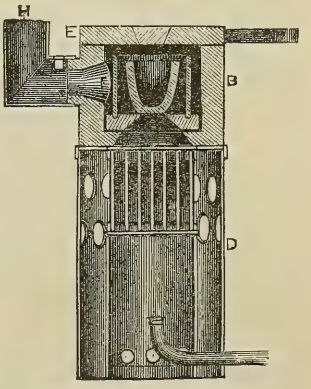
Fig. 102



Foot bellows

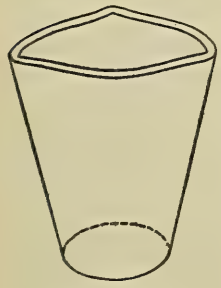
be used in connection with it for producing the blast. The sides of this bellows are of stout leather, and the reservoir of air beneath is obtained by stretching and fastening a circular piece of thin rubber cloth over the lower orifice and preventing too great expansion and rupture by enclosing it in a net. This form, with the reservoir below, is preferable to that formerly in use, which had the rubber cloth above; the advantages are greater protection against injury from falling articles, and less obstruction to the valves through drawing in dust from the floor.

Fig. 104



Fletcher's gas crucible furnace

Fig. 103

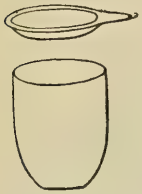


Hessian crucible

Crucible Operations.—A crucible is a cup-shaped vessel made of platinum, silver, fused silica, black lead, iron, porcelain, wedgwood-ware, or clay, and intended to withstand a very powerful heat. It is used for fusing metals or heating metallic oxides or organic substances, and is very useful in chemical analysis. The Hessian crucible (see Fig. 103) is the cheapest. It is unfitted for delicate operations, for, although capable of withstanding great heat, its porous character permits the ready absorption of many substances. The black lead crucible is more expensive. It is less porous, is infusible, and has the merit of bearing great changes in temperature without risk of fracture. Porcelain or wedgwood

crucibles are fragile, and have to be very gradually cooled to prevent breakage. Fletcher's gas crucible furnace (see Fig. 104) is very useful in this connection. Of the metals used in making crucibles, platinum is superior to all. Its well-known power of resisting fusion, its cleanliness, and its non-liability to be acted upon by most chemical substances render it invaluable to the chemist, notwithstanding its costliness (see Fig. 105).

Fig. 105



Platinum crucible

Crucibles made from fused silica are now often used to replace the more expensive platinum. Such crucibles are not affected by mineral or organic acids, except by hydrofluoric acid and, at temperatures over 400° C., by phosphoric acid. They are non-porous, insoluble in water, may be heated up to 1200° C. without injury, and possess a low co-efficient of expansion so that they are not readily broken by sudden changes in temperature. For lifting a hot crucible from the furnace, crucible tongs are employed (see Fig. 106).

1. *Ignition*, in the sense in which it is used in the Pharmacopœia and by chemists generally, is the process of strongly heating solid or semi-solid substances, the residue left at the conclusion of the process being the object sought. The U. S. P. IX quantitative test for bismuth subcarbonate affords an example of the use of this process.

2. *Fusion* is the process of liquefying solid bodies by the application of heat without the use of a solvent, as in the melting of wax.

3. *Calcination* is the process of separating volatile substances from fixed inorganic matter by the application of heat without fusion. Its principal use in pharmacy is in the expulsion of water and carbon dioxide from carbonates, as in making magnesia.

Fig. 106

Crucible tongs

4. *Deflagration* is the process of heating one inorganic substance with another capable of yielding oxygen (usually a nitrate or a chlorate); decomposition ensues accompanied by a violent, noisy, or sudden combustion. Deflagration is used in making some of the salts of antimony and arsenic, and in some qualitative work.

5. *Carbonization* is the process of heating organic substances *without* exposure to air until the volatile products are driven off, and the residue assumes the black color characteristic of free carbon or charcoal. The manufacture of boneblack and wood charcoal affords good illustrations.

6. *Torrefaction* (known also as roasting) is the process whereby organic substances have some of their constituents modified by the application of a degree of heat somewhat less than that necessary to carbonize them. The most familiar example of this process is the roasting of coffee. Rhubarb in coarse, dry powder, when subjected to torrefaction, loses its cathartic properties, but retains its astringent qualities, and is known as *Torrefied Rhubarb*.

7. *Incineration* is the process of strongly heating organic substances *with* access of air until all the carbon is consumed, the ashes which remain being the object sought. The process is frequently used in

analysis to determine the amount of fixed matter in an organic substance.

8. *Sublimation* is the process of separating a volatile solid substance from one which is not volatile by the application of heat. A special chapter on this subject will be found in the succeeding pages.

Operations requiring Heat in which Lower Temperatures are used

In this class of operations will be found the most important of those requiring the application of heat; almost all medicinal substances have their properties altered by the action of heat, and many cases are met with where it is necessary to moderate the heat carefully in order to prevent the decomposition or destruction of the active agent; for the purpose of controlling heat various baths are used, as the sand bath, oil bath, solution bath, steam bath, water bath, etc.

Baths.—The *sand bath* is usually an iron vessel of hemispherical or other convenient shape, containing dry, clean sand (see Fig. 107); the vessel to be heated is embedded in the sand, and the bath is then heated to the required degree. The object of this form of bath is to equalize the temperature, and to prevent a too sudden rise or fall of heat whereby unequal expansion or contraction might cause fracture to a glass or porcelain vessel being heated. Iron wire clippings have sometimes been substituted for sand, with doubtful advantage, however.

Fig. 107

Sand bath

The practical error usually made by inexperienced operators in the use of the sand bath is in permitting too large a body of sand to rest between the bottom of the vessel to be heated and the flame; this results in an unnecessary waste of heat.

The *oil bath* is designed to furnish a regulated temperature below 260° C. (500° F.). A fixed oil is the medium usually employed for communicating the heat, but one of the best substitutes for oil is petrolatum. Most fixed oils, when heated above 177° C. (350.6° F.), evolve disagreeable fumes.

In fractional distillation on a large scale, oil baths are often used to control temperature, and the fumes arising from the heated oil are carried off by a pipe to the chimney.

The glycerin bath.—In order to avoid the disagreeable odors arising from hot oil, glycerin is sometimes substituted. Acrolein, an acrid, volatile product, however, is produced if glycerin is heated nearly to boiling. A temperature of 250° C. (482° F.) can be maintained in a glycerin bath without much inconvenience.

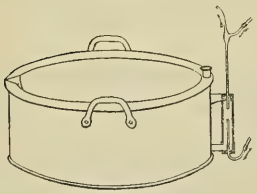
Salt water baths are sometimes used in special operations; their principle of action depends on the fact that the boiling point of a liquid is raised in proportion to the quantity of fixed salt dissolved in it. Water, as is well known, boils at 100° C. (212° F.), but if common salt is dissolved in water until it ceases to take up any more, and a saturated solution is produced, it is found that this solution does not boil until the temperature of 108.4° C. (227.1° F.) is reached. The following table shows the boiling point of certain saturated solutions as determined by Legrand and others:

Table of Boiling Points of Saturated Solutions of Various Salts

Salt	Boiling Point		Salt	Boiling Point	
	C.	F.		C.	F.
Sodium Chloride	108.4°	227.1°	Sodium Acetate	124.4°	256°
Ammonium Chloride . . .	114.2°	237.6°	Potassium Carbonate . . .	135°	275°
Potassium Tartrate	114.7°	238.5°	Calcium Nitrate	151°	303.8°
Potassium Nitrate	115.9°	240.2°	Potassium Acetate	169°	336.2°
Sodium Nitrate	121°	249.8°	Calcium Chloride	179°	354.2°

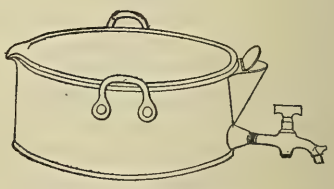
The *water bath* is one of the most useful of all the forms of pharmaceutical apparatus for regulating temperature, and the frequency with which it is directed to be used in works of authority indicates its importance as a necessary implement in the equipment of every pharmaceutical laboratory. Almost all the water baths used by pharmacists are extemporized, and these are generally crude and inconvenient; two dishes usually suffice, one of them somewhat larger in diameter than the other. Water is poured into the larger dish, and the other dish, containing the liquid to be heated, is placed in the water and the heat applied; the room is soon filled with the escaping steam, and in winter the condensation of the moisture upon the windows is alone a sufficient inconvenience to render it undesirable. Fig. 108 shows a tinned copper water bath in which this annoyance is overcome. The water level has at its lowest point a piece of block tin tube soldered in; this extends half way up the glass tube in the inside, while a perforated cork at the upper end of the glass tube permits the insertion of another piece of block tin tube; the upper tube connects with the cold water faucet and terminates in the smokeflue or with the outside air; the vapor arising from the boiling water either passes off into the chimney, as shown by the arrow, or is condensed, the loss being supplied by a small stream of water from the cold

Fig. 108



Water bath

Fig. 109



Water bath (porcelain dish)

water faucet, shown by the arrow pointing downward; the lower block tin tube acts as an overflow, the excess of water being carried off by a rubber tube into the sink; all possibility of the water bath "boiling dry" is thus obviated. Vapors from the liquid in the water bath may be carried off by a hood (see Fig. 148). A simple water bath may be made by encasing a tinned copper round bottomed dish in one of larger diameter having a flat bottom. Water is poured in through a tubulure in the top, and it is replenished as required. Fig. 109 shows a similar water bath, a porcelain evaporating dish taking the place of the copper one. It is useful where a metallic

dish would be acted on by the substance to be heated. A water bath intended for the smaller operations of analytical chemistry is shown in Fig. 110. The different sizes of the rings render it convenient for vessels of various shapes and sizes. It will be necessary to allude frequently hereafter to the uses and modifications of the water bath.

The Use of Steam in Pharmaceutical Operations

The scope of this work will not permit of any extended consideration of the use of steam in technical pharmacy, yet it is of vital interest to be acquainted not only with the theories underlying its employment, but also with the apparatus used in its practical application.

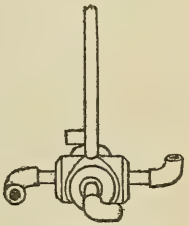
Fig. 110

Copper water bath

Fig. 111

Open steam bath

Fig. 112



Steam distributor

When water is heated to the boiling point and steam is produced, a certain amount of heat is absorbed (or apparently lost). This has been termed *latent heat.* When steam comes in contact with surfaces having less heat than itself, it is condensed, water is produced, and the latent heat becomes *sensible* (or reappears), thus proving the well established physical law that *when a liquid assumes the gaseous state, a certain fixed and definite amount of heat disappears; and, conversely, when a gas or vapor becomes a liquid, heat to a corresponding extent is evolved.* Watts has illustrated this as follows: "When water at 0° C. is mixed with an equal weight of water at 100° C., the whole is found to have the mean of the two temperatures, or 50° C. On the other hand, 1 part by weight of *steam* at 100° C., when condensed in cold water, is found to be capable of raising 5.4 parts of the latter from the freezing point to the boiling point, or through a range of 100° C. Now, $100 \times 5.4 = 540$; that is to say, steam at 100° C. in becoming water at 100° C. parts with enough heat to raise a weight of water equal to its own (if it were possible) 540° of the Centigrade thermometer, or 540 times its own weight of water one degree of the same." When water passes into steam the same quantity of sensible heat becomes latent. A consideration of these facts in physics leads to the practical application of steam as a transmitter of heat, whereby heat from any source may be absorbed by steam and carried through suitable pipes to the vessel designed to be heated. If this vessel is filled with a cold liquid, the latent heat of the steam is rapidly communicated to the liquid, the steam is condensed, and the result is this most convenient and economical method of producing a temperature which is capable of being regulated with great exactness.

Steam Baths.—These may be divided into two classes: 1, those in which steam is used without pressure; 2, those in which steam is used under pressure.

1. *The Use of Steam without Pressure.*—In many cases open steam, as it is termed, is used (see Fig. 111). The pipe which conveys the steam from the boiler is conducted to the bottom of a hemispherical kettle, and the liquid to be heated is poured into a dish of larger diameter, which is placed upon the top ; the steam is turned on, and as it condenses is carried off by the drip pipe. A temperature of about 100° C. (212° F.) can usually be maintained by this method.

Sometimes the steam pipe is conducted directly from the top into the liquid to be heated. A steam distributor, as shown in Fig. 112, may be used at the end of the pipe near the bottom of the kettle ; it is made by screwing a cross upon the end of the pipe, and an elbow to each arm of the cross ; the steam issues usually with some force from each elbow and effectually stirs up the liquid, and rapidly produces a uniform temperature in it. The principal disadvantages about using steam in this way are the noise at first produced by the contact of the hot steam with the cold liquid, and the increase in bulk of the liquid through the condensation of the steam.

2. *The Use of Steam under Pressure.*—This is by far the most convenient method of using steam practically as a means of transmitting heat. It has been stated that steam produced in open and unconfined vessels, with the ordinary pressure of the atmosphere, has the temperature of 100° C. (212° F.). If water is heated continuously in a boiler capable of withstanding pressure, the water is prevented from boiling by the pressure of its own vapor, and the temperature of the steam rises in proportion as the pressure increases. It is usually stated that the pressure of the atmosphere is 14.7 pounds to the square inch. The following table shows the increase in temperature of steam when the pressure exceeds that of the atmosphere. Of course, the opposite effect is produced when the pressure is removed, and the water boils below the temperature of 100° C. (212° F.). (See vacuum apparatus.)

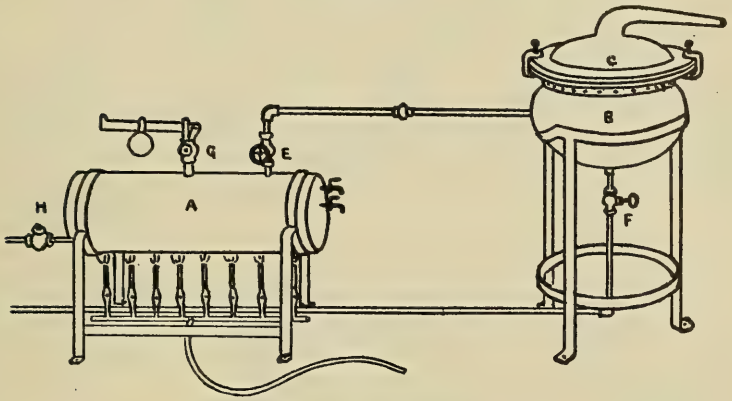
Table of the Temperatures of Superheated Steam

Pressure	Temperature of Steam		Pressure	Temperature of Steam	
Pounds per Square Inch	C.	F.	Pounds per Square Inch	C.	F.
14.7	100°	212°	55	141.6°	287°
17	104.2°	219.6°	60	144.7°	292.7°
20	108.8°	228°	65	147.7°	298°
23	113°	235.4°	70	150.5°	302.9°
25	115.6°	240.1°	75	153°	307.4°
30	121.3°	250.4°	80	155.5°	312°
35	126.2°	259.3°	85	157.8°	316.1°
40	130.7°	267.3°	90	160°	320°
45	134.6°	274.4°	95	162.2°	324°
50	138.3°	281°	100	164.4°	327.9°

The principle of the use of steam under pressure is shown in the apparatus (see Fig. 113). It was designed by the author in 1872 to illustrate the subject practically upon the lecture table. A cylindrical copper boiler, A, supported by a stout iron stand, is heated by a row of six Bunsen burners ; water is forced into the boiler from the hydrant through a rubber hose attached to the pipe connected with

the check valve, H. The steam passes into the jacketed kettle, B, and is controlled by the steam valve, E, the exhaust steam and condensed water passing through the pipe controlled by the valve F. The safety valve, G, warns the operator by "blowing off" steam

FIG. 113



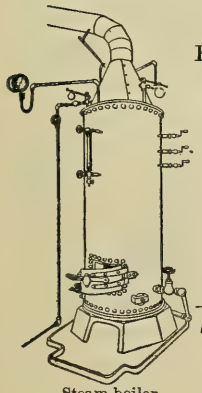
Use of steam under pressure

when the pressure has reached the highest point desired. C shows the dome which may be attached when a liquid is to be distilled.

An upright tubular steam boiler, suited to operations in the pharmaceutical laboratory, and a sectional view of the same, are shown in Figs. 114 and 115.

Prof. Patch contrived a very convenient upright tubular steel boiler. It is covered with asbestos composition, which acts as a non-conductor of heat, and the source of heat is a large coal oil stove; a conical coil of pipe serves to support a funnel when hot filtration is needed, while a safety valve and steam gauge assure safety. It is, of course, intended only for the laboratory of a retail druggist.

FIG. 114

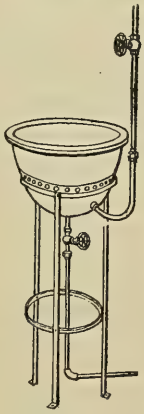


Steam boiler

FIG. 115

Sectional view

FIG. 116

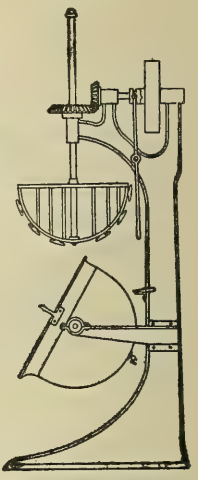


Steam kettle

The usual form of steam kettle is shown in Fig. 116. A copper pan, tinned inside, having flaring sides to facilitate evaporation, is securely connected about midway from the bottom with another copper pan, both being riveted together. An opening for the steam pipe is made in the jacketed side to admit steam, and at the lowest point of the bottom another pipe is attached to carry off the water which is produced by the condensation of the steam. The upper edge of

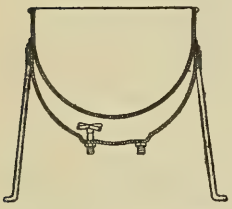
the kettle is protected by a flat brass ring, which is soldered and riveted to it, and which also serves to support the still top when the steam kettle is used for distillations. (See chapter on Distillation.) Care should be exercised to have the bottom of the kettle made of copper heavy enough to resist the greatest amount of steam pressure that will be likely to be used on it, as instances have been known of collapse when this was neglected. In using the steam kettle, the liquid that is to be heated is run into it by a syphon or other means; the drip or exhaust cock below is opened partially, and the steam slowly turned on. The habit of opening steam valves cautiously is one that should be sedulously cultivated, as accidents and strains to steam apparatus often arise from the sudden shocks due to want of care in this respect. While the liquid is becoming heated, the condensed water should be allowed to escape freely, and when the proper temperature is reached, the steam valve should be carefully adjusted and the exhaust valve turned so that, while all the condensed water may escape, no steam shall be allowed to go to waste by its being opened too widely. One of the greatest objections to the use of tinned copper kettles is that the coating of tin soon wears off, and the contamination of an evaporating liquid with copper is almost sure to result.

Fig. 119



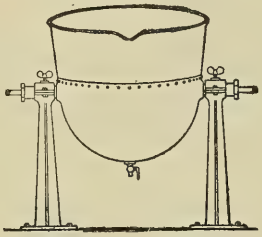
Tilting steam kettle with stirrer

Fig. 117



Steam kettle (sectional view)

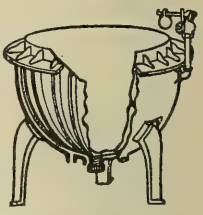
Fig. 118



Steam kettle on trunnions

Fig. 117 represents a sectional view of a steam kettle, showing the space for steam and a four-arm, steam distributor with outlet. Fig. 118 shows a steam kettle mounted on trunnions. This form is very convenient when the operator wishes to pour out the contents. In the ordinary form of the kettle the contents have to be removed with a dipper. Fig. 119 shows a modern form of steam kettle with a stirring apparatus which is easily removed when not in use. The tilting kettle is very convenient.

Fig. 120



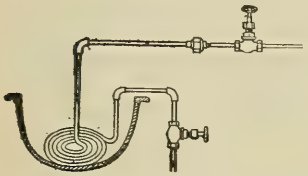
Enamelled steam kettle

The enamelled cast iron kettle shown in Fig. 120, is to be preferred on this account, although the injurious cracking of the enamel from overheating and the resulting exposure of the liquid to the iron surface beneath is an objection. It is proper to state that with care the enamel may often be retained for years in perfect condition. The great improvements in the process of enamelling as

shown in modern bathtubs give promise of having pharmaceutical apparatus in the near future of excellent quality. Jacketed iron tanks lined with sheet block tin are very useful and durable, but their costliness is apt to prevent their extended use.

Pressure steam is frequently passed through coils of iron, block tin, or lead, which have been immersed in the liquid to be heated. Fig. 121 shows the usual form. It will be found very useful to the prac-

Fig. 121



Kettle with steam coil

Fig. 122

Upright steam coil

Fig. 123

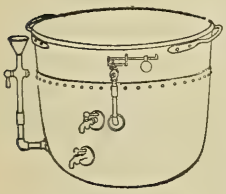
Horizontal steam coil

Fig. 124

Zigzag steam coil

tical worker to use block tin pipe. Steam valves may be soldered to both ends of the pipe, and on account of the flexibility of the pipe it may be readily adjusted and coiled to suit available space, while the absence of danger from contamination when used for heating most medicinal liquids is an advantage which should not be overlooked. Steam, when passed through coils of various shapes, zigzag pipes, etc., is also largely used in heating liquids in special operations, in drying drugs, chemicals, etc. Figs. 122, 123, and 124 illustrate these forms. (See also chapter on Desiccation.)

Fig. 125



Steam kettle for use over naked fire

Pressure Steam without the Use of a Boiler.—In Fig. 125 is shown a water bath jacketed kettle, which generates its own steam; it may be used over a gas burner, coal oil stove, or naked fire. Two gauge cocks indicate the quantity of water in the kettle, and the safety valve the amount of steam pressure; the funnel pipe is used for charging the kettle with water. The advantages of this kettle are apparent, the principal one being that it can be used by a pharmacist who desires to use steam heat without incurring the inconvenience and expense of installing a boiler in his store, laboratory, or cellar.

QUESTIONS ON THE USE OF HEAT

What is a blowpipe, and how is it used? (See page 136.)
What is it used for?
How is a gas blowpipe arranged?
What is the construction of a foot bellows?
What is a crucible, and what is its use?
Of what materials are crucibles made?
What sort will bear great heat without danger of breaking?
What is the best metal from which to make crucibles, and why?
What are the advantages of fused silica crucibles?
What processes require the application of high heat?
What is ignition? Give an example of ignition.
What is fusion? Give an example of an official preparation in which this process is used.
What is calcination?
What is deflagration?
What is carbonization? Give an illustration.
What is torrefaction? Give an illustration.
What is incineration?
What is sublimation?
In operations requiring lower temperatures, what contrivances are used for controlling the heat?
What is a sand bath?
What is an oil bath?
What temperature does an oil bath furnish?
What temperature does a glycerin bath furnish?
What temperature does a salt water bath furnish?
What is a water bath?
What is latent heat?
When water at 0° Centigrade is mixed with an equal weight of water at 100° Centigrade, what is the temperature of the mixture?
How much water will 100 parts (by weight) of steam raise from the freezing point to the boiling point?
What two classes of steam baths are used?
What temperature can be obtained by an open steam bath?
What is the pressure of the atmosphere to the square inch?
If water be heated continuously under pressure, what will be the result?
What would be the temperature of a steam bath carrying 100 pounds pressure to the square inch?
Describe an upright tubular steam boiler.
What is the objection to using tinned copper steam kettles?
What is the objection to using enamelled cast iron steam kettles?
What form of jacketed steam kettle is most convenient?
How may steam under pressure be used in vessels which are not jacketed?
Describe the construction of a jacketed steam kettle to be used over a naked fire without a boiler.

CHAPTER IV

VAPORIZATION

UNDER this head will be included those pharmaceutical operations in which volatile substances are separated from fixed bodies, or from others which are less volatile, by the action of heat at varying temperatures. Vaporization is frequently employed in pharmacy, and it will be most convenient to consider its applications in the order of their importance: 1. To Liquids. 2. To Solids.

1. When vaporization is used to separate a *volatile liquid* from a *less volatile* liquid, it is called *evaporation.*

2. When the object sought is the *volatile liquid,* it is called *distillation.*

3. When it is used to separate a *volatile liquid* from a *solid,* it is called *desiccation, exsiccation,* or *granulation.*

4. When it is used to separate a *volatile solid* from another body, it is called *sublimation.*

The following diagram may serve to impress the definitions on the memory:

Vaporization

Object Sought	Process
Liquids:	
Fixed or less volatile	Evaporation
Volatile	Distillation
Solids:	
Fixed	Desiccation, Exsiccation, Granulation
Volatile	Sublimation

The subjects of Evaporation, Distillation, Sublimation, and Desiccation will be considered in the chapters which immediately follow. Vaporization, as applied to Granulation and Exsiccation, will be more appropriately considered after the chapters on Solution and Crystallization.

Evaporation

Although this term has in its more popular sense the signification of the separation of moisture from any body, whether solid or liquid, in pharmacy the word has a more restricted meaning, and signifies the driving off of the more volatile or less valuable portions of a liquid by the application of heat, with the object of purifying it or obtaining the less volatile portion. Illustrations are found in the concentration of syrups and liquids intended for crystallization, and in the treatment of weak tinctures in making fluidextracts and extracts.

As *ebullition,* or *boiling,* is an important form of evaporation, it will be necessary first to consider the essential points concerned therein. Ebullition in a heated liquid is caused by the formation of bubbles of vapor upon the surface of the vessel, which, rising to the surface of the liquid and bursting, permit the vapor to become diffused in the

space above the boiling liquid. The *boiling point* of a liquid may be defined as the temperature at which the tension of its vapor is equal to the pressure of the atmosphere, this point being *definite*, while *evaporation* takes place in the same liquid at nearly all degrees of heat, and hence the *evaporating* point is an *indefinite* temperature. The point at which a liquid boils varies with the liquid.

Fig. 126

Boiling point test

The boiling point of a liquid is affected by the cohesion of the liquid and the degree of pressure upon its surface. Water under the ordinary pressure of the atmosphere boils at 100° C. (212° F.). When confined in a steam boiler it has been shown that water can have a temperature considerably over 200° C. (392° F.) without boiling, the bubbles being prevented from rising to the top on account of the pressure of the steam in the confined space above the liquid. On the other hand, the removal of pressure causes a liquid to boil below its normal boiling point.

Determination of Boiling Points.—One of the simplest methods of ascertaining the boiling point of a liquid is illustrated in the cut (see Fig. 126). The liquid is introduced into a test tube, and a glass tube is selected of such diameter as will permit a tube thermometer to pass easily through it and leave a small space between; the tube should be about one inch shorter than the thermometer. A short piece of wire should be passed through the glass ring of the thermometer, and slightly bent to hold it in position; a perforated cork should now be fitted tightly to the test tube, and the tube carrying the thermometer tube pushed through the perforation in the cork until the bulb of the thermometer is just above the liquid; heat should be applied cautiously by a sand bath or water bath. The vapor from the boiling liquid passes upward through the whole length of the thermometer, escaping at the top, and thus the error common to some methods, due to the difference in temperature between the portion of the thermometer in the test tube and that outside of the test tube, is measurably avoided.

The official method is as follows:

U. S. P. IX Method for Determining Boiling Points

The boiling point is defined as that range of temperature within which at least 95 per cent., by volume, of the substance distils, when treated as directed below.

Apparatus Required.—A distilling bulb of from 50 to 60 mils capacity to the lower part of the neck, the length of the neck from 10 to 12 cm. and the internal diameter from 14 to 16 mm. The outlet tube of from 4 to 5 mm. internal diameter should be attached to the neck at approximately its midpoint, forming an angle of from 70° to 75° with the lower end of the neck.

A straight glass condenser with a water jacket from 40 to 60 cm. in length; the distance from the upper end of the water jacket to the neck of the bulb being from 18 to 25 cm.

Thermometer.—In order to avoid the necessity of an emergent stem correction, it is advisable that an accurately standardized thermometer of the Anschutz type be used. If such a thermometer is not available, a thermometer used for melting points (see page 130) may be employed, applying the emergent stem correction as described under *Melting Points* (see page 131), the length of emergent stem being measured, in degrees, from the lower end of the stopper to the highest point of the boiling temperature. When placed in position the lower end of the thermometer is 2 to 3.5 cm. below the center of the orifice of the outlet tube.

An asbestos board, of from 12 to 15 cm. square and from 3 to 5 mm. in thickness, having a circular perforation, located centrally, for the reception of the bulb. The edge of the asbestos around the perforation should fit closely to the bulb when the latter is set into it. The size of the perforation should be such that, when the bulb is set into it, the portion of the bulb below the upper surface of the asbestos will have a capacity of from 3 to 4 mils.

Procedure.—Place the asbestos board on a tripod or other suitable support. Introduce into the distilling bulb 25 mils of the liquid to be tested, insert the thermometer, stand the bulb in an upright position in the perforation of the asbestos board and connect it with the condenser. Then distil the liquid at the rate of 1 mil for each fifteen to twenty seconds, noting the temperature as soon as 5 drops of the liquid have distilled into the receiver and when 95 per cent. of the original volume has distilled. Correct the reading for any difference in the barometric pressure by allowing 0.1° C. for each 2.7 mm. difference from the standard pressure of 760 mm., adding if the pressure is lower, and subtracting if higher.

NOTE.—In order to have the entire distillate distil over at the prescribed rate, it is best to make a preliminary distillation of a separate portion of 25 mils of the liquid, during which the source of heat (a good Bunsen burner) is regulated so that the distillation proceeds at the prescribed rate. Having thus regulated the burner, temporarily remove it, clean the bulb, recharge it with a fresh portion of 25 mils of the liquid and proceed with the distillation as described above. Boiling points are used as a means of determining the identity and purity of various substances, and the appended table gives the boiling points of substances according to the U. S. P. IX.

Table of Boiling or Distilling Points of Official Substances

Æthylis Chloridum		12°–13° C.	=	53.6°–55.4° F.
Æther	about	35° C.	=	95° F.
Benzinum Purificatum		40°–80° C.	=	104°–176° F.
Acetonum		56°–58° C.	=	132.8°–136.4° F.
Chloroformum	about	61° C.	=	141.8° F.
Spiritus Ætheris Nitrosi		65° C.	=	149° F.
Alcohol	about	78° C.	=	172.4° F.
Aqua		**100° C.**	=	**212° F.**
Glycerin (when between 70 and 100 per cent.) volatilizes rapidly at		100° C.	=	212° F.

Acidum Nitricum . . . . . volatilizes at	110° C.	=	230° F.
Acidum Aceticum Glaciale	117°–118° C.	=	242.6°–244° F.
Paraldehydum	120°–125° C.	=	248°–257° F.
Bromoformum	148° C.	=	298.4° F.
Oleum Sinapis Volatile	148°–154° C.	=	298.4°–309.2° F.
Oleum Terebinthinæ, 90 per cent. distils between	154°–170° C.	=	309.2°–338° F.
Terebenum	160°–172° C.	=	320°–341.6° F.
Eucalyptol	174°–177° C.	=	345.2°–350.6° F.
Phenol Liquefactum . . . . . not above	182° C.	=	359.6° F.
Cresol, 90 per cent. should boil between . . .	195°–205° C.	=	383°–401° F
Guaiacol (liquid), 85 per cent. should distil between	200°–210° C.	=	392°–410° F.
Creosotum, 80 per cent. should boil between .	200°–220° C.	=	392°–428° F.
Methylis Salicylas	218°–221° C.	=	424.4°–429.8° F.
Eugenol	250°–255° C.	=	482°–491° F.
Hydrargyrum . . . . . about	358° C.	=	725° F.
Zincum	940° C.	=	1724° F.

Tension of Vapors.—If a glass tube, thirty-six inches long, closed at one end, is filled with mercury, and the open end, after closing it with the finger, carefully inverted in a beaker containing mercury, it will be found that the mercury will run out from the tube into the beaker until a column of mercury about thirty inches in height is left. This column is sustained by the pressure of the atmosphere, and is, in fact, the well known mercurial barometer tube. The six inches of space in the tube above the level of the mercury is, of course, empty, or vacuous. Now, if a few drops of water are passed into the tube by a dropper, they immediately rise to the level of the mercury in the tube, and, although the temperature has not been increased, a portion of the water is vaporized, and the column of mercury is proportionately depressed. This depression is due to the elasticity or tension of the aqueous vapor. If the tube be forcibly pushed down into the mercury, the increased pressure will be found to have liquefied the vapor, and the original quantity of water is recovered; but the depression in the column of mercury may be increased by heat, and when a sufficient amount of heat has been applied to the tube to expel the mercury until none is left in the tube, it will be found that the temperature marks 100° C. (212° F.), which is exactly the boiling point of the liquid (water), showing that this point must be reached in order to overcome the pressure of the atmosphere. If alcohol or ether be substituted for water, it will be found that the mercury will be depressed in a far greater ratio,—this being due to the greater

volatility and lower boiling point of these liquids. The *maximum density* of the vapor of a volatile liquid in a confined space in contact with the corresponding liquid is reached when its elastic force attains the limit beyond which pressure produces the liquefaction of the vapor. When this limit is reached, the vapor is said to be *saturated.* Maximum density varies with the temperature. If a saturated vapor in an enclosed tube is not in contact with an excess of liquid, increase of temperature lowers its density or expands it. On the other hand, when a saturated vapor is cooled, liquefaction gradually takes place, the vapor above the liquid remaining in the condition of maximum density until converted into the liquid. So that *cold* and *pressure* have the effect of *converting vapors into liquids,* while *heat* and the *removal of pressure* have the reverse effect,—*i.e., the conversion of liquids into vapors.* The phenomena above described characterize evaporation into a space filled with air as well as evaporation into a vacuum, the only difference being that more time is required to produce the same effects when evaporating in contact with air, for volatile liquids are instantly converted into vapor in a vacuum, while the presence of air retards, but does not prevent, vaporization. A consideration of the foregoing facts leads to the following deductions :

1. The quantity of vapor that will form in a confined space depends upon the amount of pressure and heat to which the liquid is subjected, and when the point of maximum density of the vapor is reached, evaporation ceases if the pressure and temperature remain the same.

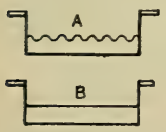
2. The rapidity of evaporation of an aqueous liquid in the open air is influenced by the condition of the aqueous vapor always present in the air. If it has the greatest density possible for the degree of heat, evaporation is retarded ; but if the aqueous vapor in the atmosphere is much below the state of maximum density, as is usually the case, evaporation is promoted.

3. Rapidity of evaporation is increased by removing the pressure of the atmosphere.

4. Increase of temperature obviously accelerates evaporation, by increasing the formation of vapor.

Evaporation of Liquids by Boiling.—In evaporating *by boiling,* temperature, pressure, etc., being equal, the rapidity of the process depends upon the *extent of surface exposed to the heat.* Fig. 127 represents a cross section of two evaporators, A and B. The corrugated bottom of A gives twice as much surface as the smooth bottom of B, and hence if the same quantity of a liquid is made to boil in each, at the same temperature, the bubbles of vapor given off from the corrugated bottom will be twice as numerous as those formed on the plain bottom. The superiority of tubular boilers over the ordinary plain or Cornish boiler also affords a good illustration of this fact (see Fig. 115).

FIG. 127



Evaporation by boiling

When a pure, volatile liquid is heated to the boiling point in the open air, its temperature remains the same until the whole of the liquid has evaporated. If, on the other hand, solid matter is dissolved in the liquid, the temperature of the solution is gradually in-

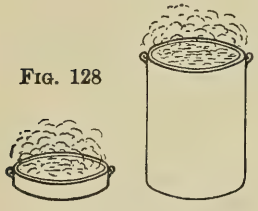
creased until saturation is reached. This fact is well illustrated by considering boiling points of saturated solutions of various salts (see page 140), and it shows the importance of diminishing the heat in the evaporation of solutions of organic substances as evaporation progresses, as, for example, in the making of extracts, etc.

The cohesion of a liquid affects its boiling point, dense, thick, and sticky liquids offering more resistance to the escape of the bubbles of vapor than rare, mobile, or thin liquids.

The relative depth of liquid also influences the boiling point. Shallow vessels favor ebullition, because they afford proportionally less weight of liquid above the bottom of the dish for the bubbles to escape through than deep ones. Rough metallic surfaces favor

Fig. 129

Fig. 128



Evaporating below boiling point

Fig. 130

Porcelain evaporating dish

Fig. 131

Glass evaporating dish

evaporation by boiling, and are better than smooth surfaces, because they expose a greater amount of surface to the source of heat.

Evaporation below the Boiling Point.—In evaporating liquids *below their boiling point*, temperature, pressure, etc., being equal, rapidity of evaporation depends upon the *extent of surface exposed to the air*. Figs. 128 and 129 show two vessels of exactly the same diameter, but of different capacity, containing water. Both expose the same amount of surface to the air, but that of Fig. 129 contains eight times more liquid than that of Fig. 128.

If both be subjected to the same temperature, *provided it be below* 100° C. (212° F.), the water will evaporate as rapidly from one as from the other.

Proper Shape of Vessels for evaporating Liquids.—Broad, shallow vessels should be used for evaporating below the boiling point, because the extent of surface is proportionally greater in vessels of this shape. Fig. 130 is an illustration of a porcelain evaporating dish having the proper shape. The chief objection to dishes of this kind is their liability to breakage. Care should be taken to dry the bottom of the dish thoroughly before placing it over a gas flame. A glass evaporating dish is shown in Fig. 131. This should always be used in a sand bath, or should be otherwise protected from direct heat. Enamelled cast iron dishes are very useful, notwithstanding the lack of durability of the enamel. Enamelled sheet iron dishes, called "agate ware," are very light, and are much more lasting than the ordinary enamelled cast iron dishes (see Fig. 132).

Fig. 132

"Agate ware" evaporating dish

Use of Stirrers.—By stirring an evaporating liquid the surface is largely increased, while the currents of air produced at the same

time greatly assist in dissipating the vapors which rise. Upon the small scale, porcelain, horn, or wooden stirrers are used (see Figs. 133 to 137), while mechanical stirrers are usually employed in the laboratory in more extensive operations (see Fig. 119). Fig. 138 also shows a rotary stirrer to be operated by steam power.

Vacuum Apparatus.—It has already been shown (page 142) that the boiling point of liquids is lowered by removing the pressure of the atmosphere. This fact is easily proved by placing under the receiver of an airpump some alcohol in a test glass containing a few pieces of broken glass,

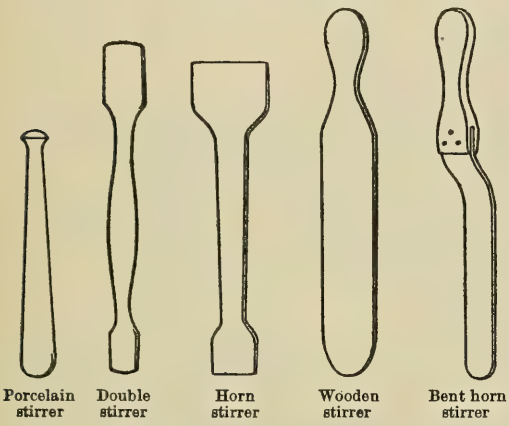
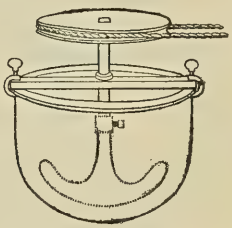


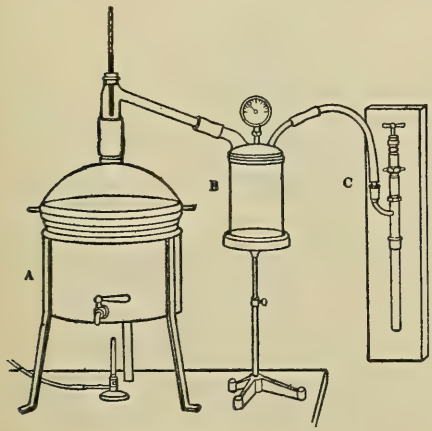
Fig. 138



Rotary stirrer

when, upon exhausting the receiver, many bubbles of vapor will rise from the surface, and the liquid will boil at the ordinary temperature. Water will boil at 84° C. (183.2° F.) upon the top of Mont Blanc, on account of the diminished pressure of the atmosphere.

Fig. 139



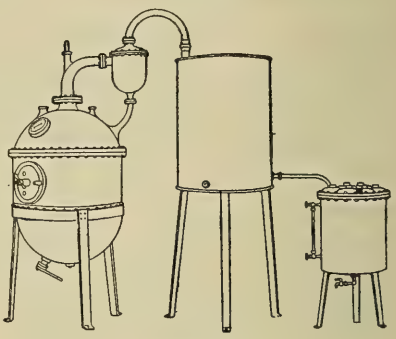
Small vacuum apparatus

The practical application of these principles is of great importance in pharmacy, and vacuum pans are frequently used in the larger laboratories for concentrating solutions which are injured by heat under the ordinary pressure of the atmosphere, and especially in evaporating solutions of organic substances, for these are almost without exception injured by heat.

In Fig. 139 a vacuum apparatus is shown which illustrates the principle of this method of evaporation. The copper vessel, A, is used either as a steam or water bath; in this is placed a tinned copper or porcelain evaporating dish covered with a glass dome fitted with an airtight connection. A thermometer is adjusted at the top, and by

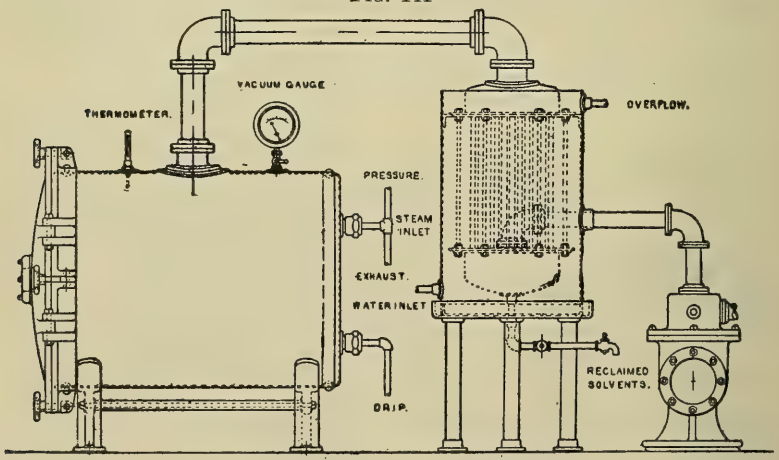
means of the water pump, C, the air is exhausted ; the glass vessel, B, acts as a receiver. It is closed by a metallic lid, which is furnished with a vacuum gauge which indicates at all times the conditions, and enables the operator to increase or decrease the "vacuum." Fig. 140 shows a larger vacuum apparatus adapted for manufacturing laboratories. At the left is seen the jacketed copper still containing manhole, eyeglasses, aircock, and drain valve, connected with an overflow vessel to be used in case of the boiling over of the contents. The condenser is mounted on a tripod, and this is connected with the receiver, which is furnished with a water gauge, drain valve, and with inlets and outlets for the vacuum pump. The air is exhausted from the entire apparatus by attaching to the receiving vessel the pipe from the pump. With the aid of this apparatus, alcohol may be recovered directly from an exhausted drug by emptying the contents of a percolator into the still. Vacuum pumps operated by steam are to be found in all well equipped pharmaceutical laboratories, and pipes and attachments are just as easily connected with various forms of apparatus as are the pipes used for conveying steam under pressure (see gelatin coated pill apparatus in Part V).

FIG. 140



Vacuum apparatus

FIG. 141



Vacuum apparatus (Stokes)

The F. J. Stokes Machine Company, of Philadelphia, have perfected a vacuum drying apparatus of much value. Fig. 141 shows in detail their application of the vacuum applied to drying substances which are moist ; the vapors may be condensed and reclaimed by the use of

the condenser. These vapors may sometimes be injurious or undesirable if allowed to escape into the laboratory, and hence this plan of disposing of them is effective ; the condenser may be disconnected, if found advantageous. Substances which require days to dry in heated rooms can be dried in several hours with this apparatus.

It frequently happens that the pharmacist is unable to devote much space to laboratory operations. This is particularly the case in

FIG. 142

Evaporating chamber

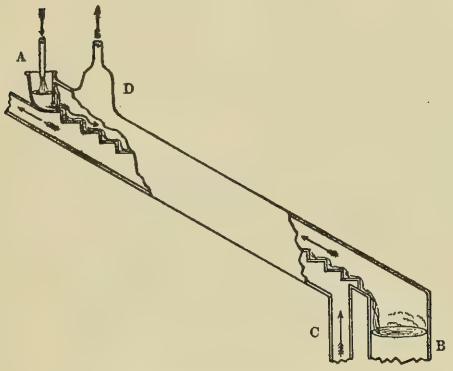
cities or large towns, where rents are high. When pharmaceutical operations must be conducted in the store, an absolutely indispensable convenience is an *evaporating chamber* (see Fig. 142). If the arrangement of the store will admit of it, this should be built into a chimney breast. The bottom of the chamber is preferably made of a slate slab, which should have a slight inclination toward the front, and be large enough to project about two inches over the closet upon which it rests, for the purpose of preventing a liquid, spilled by accident, from running into the closet and soiling the contents. The chamber should have a gas pipe in it, and the upper part should connect, by a flue in which there is a damper, with a chimney having a good draught. A wooden or galvanized iron front having a pane of glass fitting tightly in it will prevent vapors or odors from getting into the store The space below may be utilized as a closet for evaporating dishes, gas stoves, etc.

Economical Surface Evaporation.—In large industries where economy in operating is an essential factor, various forms of apparatus must be constructed to meet this need. In Fig. 143 is shown a method of concentrating sulphuric acid, whereby the hot gases from

the furnace are utilized as the source of heat. The liquid enters at A, and flows down in a thin stream over a cascade or series of steps, the vapors arising find an outlet at D, the evaporated liquid is collected in a reservoir, B, while the waste heat passes upward in the direction of the arrows through the pipe C.

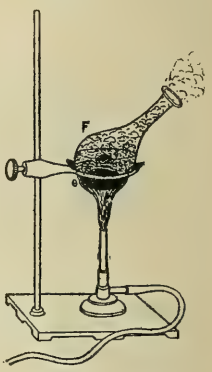
Spontaneous Evaporation.—By this term is meant the evaporation of a liquid at the ordinary temperature of the atmosphere, or without the application of strong, direct heat. It is used in cases

FIG. 143



Surface evaporation

FIG. 144



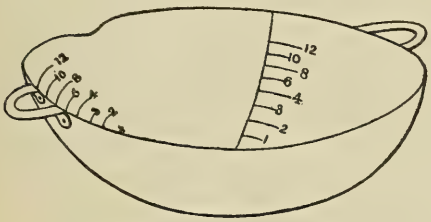
Flask evaporation

where the residue or less volatile liquid is liable to injury or loss by the application of much heat, or in crystallization, where, by the slow vaporization of the volatile liquid, finely formed crystals may be secured, and in other less important operations. Spontaneous evaporation is usually conducted in drying rooms or closets when they are accessible; these, as will be subsequently described, are rooms or closets which are very slightly heated by the use of exhaust steam or other means; or this form of evaporation may be used by placing the liquid in shallow dishes or trays and exposing the surface to the rays of the sun during fine weather. Upon the small scale, one of the most convenient methods is to support the dish upon a wire tripod placed upon a stove, at a sufficient distance above the top of the stove to avoid injury, or if heated air from a furnace is available, it can be utilized by supporting the dish, properly protected, over the register; the upward current of dry heated air greatly assists in promoting the evaporation.

Evaporation by Direct Heat.—This method usually requires the greatest amount of care in order to avoid loss or injury by overheating. It is to be preferred, therefore, only in cases where the residue is not easily injured by such an accident. The evaporation of saline solutions in crystallization, or of weak aqueous organic solutions, may usually be performed by the application of direct heat. Careful watching, however, is necessary, and also frequent stirring, to prevent the formation of a crust upon the bottom. Fig. 144 shows a method of evaporating by direct heat by using a flask, F, supported on a piece of brass wire gauze, G, upon a retort stand.

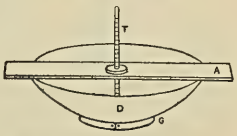
Evaporation to a Fixed Volume.—This operation cannot be performed accurately without inconvenience, and hence it is much more satisfactory to evaporate a liquid to a definite weight,—all that is necessary in the latter case being to use a tared dish, and weigh the dish and contents when evaporation has progressed to the desired point.

Fig. 145



Graduated evaporating dish

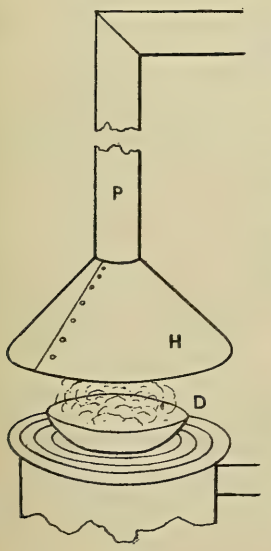
Fig. 146



Measuring evaporation

In evaporation to a definite measure, a graduated evaporating dish (see Fig. 145) may be employed, care being taken to level it by noticing that the height of the liquid is the same on each side, or the expedient illustrated in Fig. 146 may be resorted to. An ordinary evaporating dish, D, is placed upon a grommet, G (see page 158), and subjected to the heat (in this case the temperature is intended to be that of a warm room); a perforated wooden strip, A, is placed across the dish, and a glass thermometer, T, is supported in an upright position in the liquid by a perforated cork. Sufficient water is poured into the dish to equal the final measure of the liquid, and a small rubber band is slipped on the thermometer (or a piece of string tied on) to indicate the desired level of the liquid; the water is replaced by the liquid to be evaporated, and evaporation proceeded with until the liquid has been lowered to the mark on the thermometer. When the use of the thermometer is unnecessary, a notched stick may be substituted. In order to arrive at results approaching accuracy by these methods, the liquid must be allowed to cool to the temperature of the water which was used as the measure of the liquid in the beginning.

Fig. 147



Hood

Use of Hoods.—A hood is a contrivance, usually of a conical shape, intended to collect and dispose of vapors which, from their disagreeable odors or their suffocating effects, render the atmosphere of the store or laboratory unwholesome. Fig. 147 shows a form of hood which has been found useful upon the small scale. It is made of galvanized iron, and connects by galvanized stove pipe with the strong draught of a good chimney; the stove pipe running horizontally to the chimney should have a damper in it. If any condensation of the vapors takes place in the stove

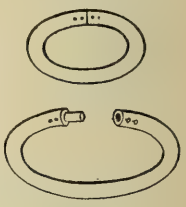
pipe, the larger diameter of the circular hood will cause the drops of liquid to fall outside of the evaporating dish, and thus contamination of the contents of the dish is avoided. Hoods are usually made of wood when intended for operations upon the large scale. Fig. 148 illustrates the method of using a hood when the dish is placed upon a stove.

Fig. 148

Stove hood

Use of Grommets.—One of the inconveniences in using round-bottomed evaporating dishes is due to the shape of the bottom, serious loss often occurring from the tilting of the dish and spilling of the contents. To obviate this, *grommets* should be used. These may be economically made from a cast off piece of rubber hose or tubing by bending it into a circle, placing a wooden plug in one end, tacking it securely, and inserting it in the other end and fastening it in the same manner (see Fig. 149). An elastic ring is thus formed, upon which an evaporating dish or round bottomed vessel may be safely placed. Grommets serve another very important purpose, that of preventing the fracture of a porcelain or glass dish containing a hot liquid, by being placed between the hot dish and the cold surface of a table or floor.

Fig. 149



Grommets

QUESTIONS ON VAPORIZATION

What is vaporization? (See page 147.)
What is evaporation?
What is distillation?
What is desiccation?
What is exsiccation?
What is granulation?
What is sublimation?
What is meant by ebullition or boiling?
What is meant by the boiling point of a liquid?
Is the boiling point of a liquid a definite temperature?
Is the evaporating point of a liquid a definite temperature?
What is the boiling point of water under the ordinary pressure of the atmosphere?
When confined under pressure, how high can its temperature be raised without boiling?
What will be the effect upon boiling if the pressure is made much less than that of the atmosphere?
How may the boiling point of a liquid be determined?
Describe the U. S. P. IX method for determining boiling points.
What is meant by the tension of vapors?
What effect have cold and pressure upon vapors?
What effect have heat and removal of pressure upon vapors?
Upon what does the quantity of vapor that will form in a confined space depend?
How is the evaporation of a liquid influenced by the presence or absence of aqueous vapor in the air?
How may the rapidity of evaporation be increased?
Why does increase of temperature hasten evaporation?
In evaporation by boiling, temperature, pressure, etc., being equal, upon what does the rapidity of the process depend?
When a pure volatile liquid is evaporated by boiling in the open air, does the temperature change with the amount evaporated?
If there is solid matter dissolved in the liquid, what takes place on evaporation?
What inference should be drawn from this,—for example, in the preparation of extracts?
Which are most easily evaporated,—thin mobile liquids or dense and thick ones, and why?
Does the depth of a liquid influence its boiling point?
Why are rough metallic surfaces better for evaporation than smooth ones?
In evaporating liquids below the boiling point, temperature, pressure, etc., being equal, upon what does the rapidity of the process depend?
Therefore, what shaped vessels should be used for evaporating liquids below the boiling point?
What effect is produced by stirring an evaporating liquid?
Will water boil at a higher or lower temperature in more elevated positions, and why?
What application is made of this principle in pharmacy?
Describe a small vacuum apparatus.
What are the advantages of drying in vacuo?
Describe the construction of a large vacuum apparatus suitable for a manufacturing laboratory.
What is an evaporating chamber, and how should it be constructed?
Describe a method of surface evaporation which is economical, yet practical.
Why is flask evaporation not satisfactory?
What is the objection to evaporating liquids by direct heat?
In evaporating a liquid to a definite measure, how may it be ascertained when the measure has been reached?
What is a hood, and what is its use? What is a grommet?
What is meant by spontaneous evaporation?
How may it be advantageously conducted?

CHAPTER V

DISTILLATION

THE first part of the process of *distillation* is identical with that of evaporation, for it is simply the *vaporization* of the volatile liquid through the application of heat. The next step is distinctive and opposite, and consists in the conversion of this vapor into a liquid by the application of cold. This part of the process is called *condensation.*

The elements of distillation are: 1, vaporization, and, 2, condensation. The subject of vaporization was treated of in the preceding chapter. We have now to consider condensation.

Condensation.—It has been already shown (page 141) that when a *liquid* is *vaporized* a certain amount of heat disappears or is rendered latent, and when a *vapor* is *liquefied* a corresponding degree of heat is evolved or reappears. While the practical application of this law is of great service in the use of steam for heating purposes, the opposite process of condensation shows its disadvantages, because of the relatively large quantity of cold water necessary to convert vapors into liquids.

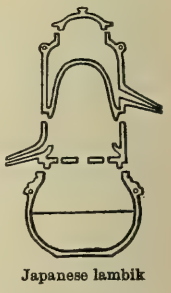
FIG. 151

Alembic

The greater the difference in temperature between the condensing surface and the vapor, the more rapid is the condensation; and it has been computed that steam at 100° C. (212° F.) requires about twenty-five times its weight of water at 20° C. (68° F.) to condense it. The proper relation between the heating and condensing surfaces of apparatus used in distillation can only be known by careful study of the laws governing vaporization and condensation, or by practical experience.

Apparatus used in Distillation.—In considering the many kinds of apparatus used in distillation, two typical forms are presented: 1, the *alembic form*, in which the vapor is condensed in an enclosed space immediately above the heated liquid, and, 2, the *retort* form, in which the vapor is condensed in a vessel placed at one side of that containing the heated liquid, and connected with it by a suitable tube or pipe.

FIG. 152



Japanese lambik

The Alembic.—This is probably the most ancient kind of distillatory apparatus, and in its original form it is now rarely employed. The *body*, or *cucurbit*, is usually globular or oval in shape, and at its junction with the hemispherical *head* or *dome* there is a gutter or groove. This serves to collect the condensed vapor or distillate, which is carried off by a tube, as shown in the illustration (see Fig. 151).

Fig. 152 shows an alembic which, according to Mr. Brady, of Newcastle, England, is still frequently employed in Japan. Into the boiler is fitted a short cylinder. This has a perforated bottom,

and the gutter communicates with the spout; the condenser has a cover, and is also furnished with a spout for carrying off the water used in cooling the dome after it has been heated by the vapors rising from the boiling liquid in the body. This still, or, as it is called by the Japanese, *lambik*, is shown because it represents the alembic probably in one of its best practical forms, and the advantages possessed by this kind of distilling apparatus are seen to be compactness and simplicity. It is, however, not fitted for distilling very volatile liquids, is very inconvenient and troublesome, because of the necessity for constantly replacing the water used in the condenser, and distillation is slow and tedious.

The Retort.—This form of distillatory apparatus has many advantages over the alembic, which it has almost entirely replaced. A retort, in its simplest form, may be described as a long necked glass flask in which the neck, after being heated thoroughly, is bent over until its axis makes an acute angle with that of the bowl of the flask. Retorts are of two kinds,—plain and tubulated. A *plain* retort is shown in Fig. 153. If it has a *tubulure* or orifice at the top of the bowl for the purpose of introducing the liquid to be distilled, it is said to be *tubulated* (see Fig. 154). Retorts are made of glass, porcelain, earthenware, platinum, iron, lead, etc., according to the purposes for which they are designed.

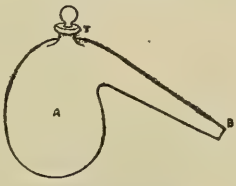
Porcelain and earthenware retorts are used in the distillation of phosphorus, mercury, etc.; platinum and iron retorts, in destructive distillation; leaden retorts, in making hydrofluoric acid, ether, etc.

The glass retort is the only kind, however, which will be considered here in detail. The shape of a retort is an important point to regard in its selection. Retorts having deep bowls are best suited for very volatile liquids. The lower surface of the neck of the retort should form a decidedly acute angle with the surface of the bowl if tubulated; a line drawn from the centre of the stopper should touch the centre of the bowl, A, so that when a funnel is introduced into the tubulure, T, to charge

Fig. 153

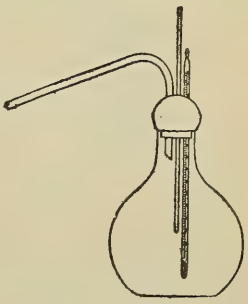
Plain retort

Fig. 154



Tubulated retort

Fig. 155



Distilling flask

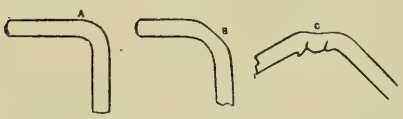
the retort, the contents may all be delivered into the bowl without soiling or splashing the neck. The neck of the retort should gradually taper to the end, and the beak, B, should never be larger in diameter than any other portion of the neck, otherwise difficulty may be experienced in making joints with adapters, receivers, or condensers (see Fig. 180). Such a fault may prevent the use of a cork ring in joining, for this ring should be made tight by forcing it up the gradually increasing diameter of the neck. The

glass forming the retort should be carefully annealed and have a uniform thickness. Extremes should be carefully guarded against. If the glass be too thick, the sudden changes in temperature, to which retorts are constantly subjected in distillation, may cause fracture; on the other hand, if too thin, they are easily broken in cleaning. Scratches and imperfections in the bowl should cause retorts to be rejected.[1] The objections to the use of retorts are mainly due to their peculiar shape, the principal one being the difficulty of cleaning them thoroughly. The necessity for having a variety of different shapes and sizes to suit special operations is greater than when distillation is performed with flasks and bent tubes.

Flask distillation will be usually found most practicable for pharmaceutical work. The best shape for a flask is shown in Fig. 155. The bowl should have a flat bottom, so that it will stand unsupported; the neck should be wide, to admit a large cork, so that there will be plenty of room for a wide bent tube, a thermometer, and a safety or charging tube. The advantages of using a flask instead of a retort for all distillations that will allow of it are several: it is easily cleaned, it is useful for other purposes, for instance as a measure, as a container, or as a receiver for the distillate; the tubes are readily replaced in case of breakage. One of the most important parts of this apparatus is the bent tube for conducting the vapor to the receiver or condenser. The diameter of the bent tube should be as large as the receiver or condenser will conveniently accommodate.

Cutting Glass Tubes.—The glass should be moderately thick and of the proper length. A glass tube may be broken neatly by scratching it across with a sharp three-cornered file, and then grasping it with both hands, one on each side of the scratch, and making a slight outward pressure, which will generally produce a clean fracture. By holding the sharp edges for a few moments in the flame the corners may be rounded so that they will pass through a cork without cutting it and making a ragged edge.

FIG. 156 FIG. 157 FIG. 158



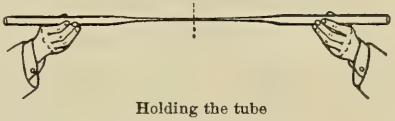
Tube properly bent — Tube unequally heated — Tube hastily bent

Bending Glass Tubes.—A tube may be bent by heating it properly over a gas flame. To make a symmetrical curve in a tube of large diameter requires considerable skill and practice. One end of the tube should be closed by a cork, and the part of the tube that is to be bent held just above the flame and gradually rotated between the fingers, so that it may be heated evenly throughout. It should also be passed to the right and left through the flame for the space of an inch or two on each side of the middle of the proposed bend, and very slowly allowed to curve in one direction, so that the bend shall not be too abrupt. The object of closing one end with a cork is to prevent a current of air from passing through, and, in case collapse from overheating occurs, by gently blowing in the tube the softened

[1] Although there is no disposition on the part of the author to weaken the force of this conventional advice, the possession of a retort having a large bubble in the bottom of the bowl, which was in successful use for ten years and has outlasted many of its more perfect fellows, supplies the needed exception.

glass may be swelled to its proper curve. Fig. 156 shows a tube properly bent, while Figs. 157 and 158 illustrate some of the defects produced by unskilled work. In Fig. 157 the tube was not rotated evenly, and at the top of the bend, B, it was hot enough to collapse. Fig. 158 represents the effects of hurry and unequal heating, the operator having forced the bend, C, before the tube was heated uniformly. A gas burner having a solid, steady flame is the best kind to use (see Fig. 73), and draughts of air should be avoided.

Fig. 159

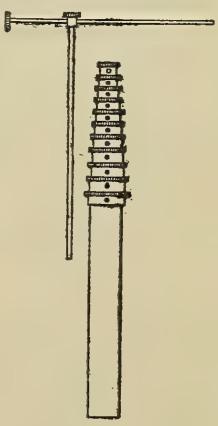


Holding the tube

In Fig. 159 the method of holding a tube while "drawing it out" over the flame to make a tapering tube is shown. The line in the centre shows the proper place to scratch it when cold with a fine, sharp, triangular file when it is to be broken apart; by holding the edge in the flame for a moment the sharpness may be rounded off. Fig. 160 shows a "well drawn" tube; Fig. 161, one which has not been revolved evenly or heated uniformly. Fig. 162 shows the same fault and careless work besides.

Cork Fitting.—Corks for joining apparatus should be of *the best quality.* They are perforated for the passage of the glass tubes by the use of cork borers (see Fig. 163). These are cylindrical brass tubes of various sizes, sharpened at one end, and surmounted by a milled brass cap. They are furnished in sets. A small hole is drilled through both sides of the brass cap, so that an iron rod may pass directly through it and form a convenient handle. They are used by holding the cork firmly with the left hand and pushing the borer through with the right hand, using a twisting motion at the same time so as to cut a smooth round hole. The mistake frequently made in using cork borers is due to "hurry." The attempt to force the borer through quickly without rotating it sufficiently always ends in breaking off pieces of the cork. The cork borer shown in Fig. 164 is more convenient for larger corks, and may be made from a piece of steel bicycle

Fig. 163



Cork borers

Fig. 160

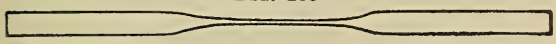
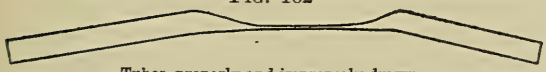


Fig. 161

Fig. 162



Tubes, properly and improperly drawn

tubing, the tool handle, I, being large enough to give the operator a firm grasp, so that the cork may be readily bored. The cutting edge of the borers should always be kept sharp and in good condition by the use of the grindstone or emery paper. When the cutters do not bore a hole of the exact size needed for the glass

tube, which of course should fit tightly, it is best to select a borer which will cut a smaller hole than that desired, and then to enlarge the hole by filing with a rat tail file (Fig. 165), or, if the hole is large, with a half round file. When the tubes have been fitted, the cork should usually be thoroughly soaked in hot water, for the purpose of swelling and softening it. It should never be soaked before cutting or filing. The rasp and file shown in Fig. 166 will be useful in fitting up large flasks. Rubber corks can often be used with great advantage, and they may be readily perforated by dipping the cork borer in solution of sodium or potassium hydroxide or strong ammonia water before beginning to use it. If rubber corks are well dried by wiping them thoroughly, they may be filed easily with a new, sharp, flat file. The main advantage of rubber corks is that they are practically impervious to vapors or gases, and hence require no luting. Substitutes for rubber corks may be made by keeping dry corks in melted paraffin or wax until the pores are thoroughly filled, and then cooling.

Fig. 165

Rat tail file

Fig. 166

Rasp and file

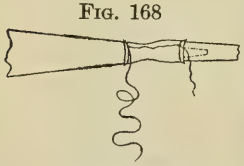
Fig. 164

Cork borer (large size)

Lutes.—The most satisfactory lute for ordinary distillations is made by adding flaxseed meal to *boiling water* and stirring until a thick, sticky mass results. When the perforated and soaked cork containing the tubes is inserted in the neck of the flask, a small quantity of lute should be pressed into the joints, and then followed by sufficient to make the joint vapor tight, the quantity varying with the quality of the cork and the character of the vapor that is to be excluded. If future trouble from leaking is to be avoided, it is usually better to throw away a cork which will not make an almost perfect joint without lute, rather than trust to cover up serious deficiencies with lute. A neat finish may be given to the joint by dipping a finger into water, and with it smoothing the surface of the lute. In Fig. 155 the cork is shown perforated and mounted, luted and in position.

Fig. 167

Fig. 168



Bladder joints

Bladder Joints.—One of the most useful substances to the practical pharmacist who has occasion to join tubes is a strip of moistened bladder. Hogs' bladders are usually preferred, and it is now possible to get them of excellent quality prepared by being thoroughly cleaned and then soaked in an alkaline solution or in petroleum benzin to deprive them entirely of fat. In connecting two tubes of different diameters which are not to be subjected to a high heat, a bladder joint is especially useful. For an ordinary joint of inch glass tube, a strip about six inches long and an inch and a half wide should be moistened and wrapped around the proposed joint; the upper end of the bladder is then tied tightly with strong linen twine, leaving the short end of the twine at least six inches long (see Fig. 168);

this end is carried along the top of the bladder and tied tightly around the lower end of the joint; the long end of the twine is then wrapped spirally and regularly around the bladder until the lower end is reached, when it should be there tied tightly (see Fig. 167). Strips of writing paper soaked for a few moments in water, and then coated with ordinary, smooth flour paste to which 10 per cent. of glycerin has been added, may also be used for joining apparatus.

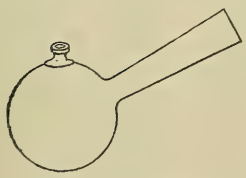
Rubber joints are preferred to bladder joints when there is no likelihood of vapor or high heat dissolving or softening the rubber, and when the tubes to be joined are nearly of the same diameter. The ease and celerity with which such joints can be made are their strong points. A piece of rubber tubing is cut of slightly less diameter than that of the tubes to be joined; by moistening the rubber on the inside with water, and stretching it over one end of the glass tube, and then inserting the end of the other glass tube, the joint is made. Success largely depends upon having the rubber tube slightly smaller in diameter than the glass tube, so that the elasticity of the rubber alone will be sufficient to make a tight joint, otherwise the rubber tube must be tied on, and then the advantage over a bladder joint is lost (see Fig. 169). In all cases it is preferable to select tubes which differ slightly in diameter, so that one may slip into the other, the narrower, of course, having the higher position, so that the vapor or liquid shall not come in direct contact with the rubber.

Fig. 169

Rubber joint

Receivers are glass vessels, usually globular in shape, intended to receive distillates. They are of three kinds,—*plain*, *tubulated*, and *quilled* (see Figs. 170 and 171). When a plain receiver is required, an ordinary flask (see Fig. 172) will answer, but if uncondensable vapors are produced, it is necessary to provide for their escape, or

Fig. 170



Tubulated receiver

Fig. 171

Tubulated and quilled receiver

Fig. 172

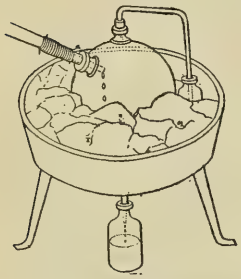
Plain receiver

an explosion may occur from the accumulated pressure. This may be done in a tubulated receiver by occasionally removing the stopper, or, better, by connecting a bent glass tube with the receiver and allowing the end of the tube to dip into water, or into an acid solution if the vapors be alkaline, or into an alkaline solution if the vapors be acid. A quilled receiver is useful where the distillation is to be carried to a definite point and a certain amount of distillate is to be received, or, as in the preparation of hydrocyanic acid, the end of the quill is made to dip below the surface of cooled diluted alcohol or water, in order to condense all of the gas. In the distilla-

tion of very volatile liquids an effective mode of using a quilled receiver is shown in Fig. 173. A hole is cut in the bottom of a rather shallow tin pan and a short tube soldered into it; a perforated cork will permit the quill of the receiver to pass through it, and at the same time a tight joint should be made; ice or snow is heaped up over the receiver, and any uncondensable gases may escape from the bent tube in the tubulure or be absorbed by the liquid into which the tube dips.

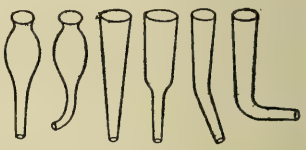
Adapters are tapering tubes of glass which are used to connect retorts with receivers. Figs. 174, 175, 176, 177, 178, and 179 show the various shapes. Good adapters may be made from retorts having broken bulbs by cutting off the broken portion, scratching the tube with a file, and extending the crack thus made entirely around it by slowly passing a red hot poker over the line marked for the fracture. Fig. 180 shows an adapter of this kind in position. Adapters are also employed to deliver the distillate from Liebig condensers into receivers or flasks.

Fig. 173



Mode of using quilled receiver

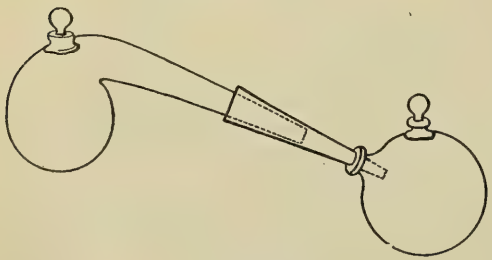
Fig. Fig. Fig. Fig. Fig. Fig.
174 175 176 177 178 179



Adapters

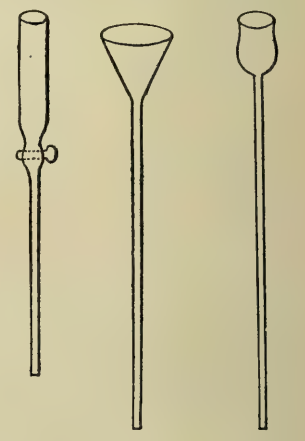
Charging Retorts.—Plain retorts must be charged by using a funnel tube; this may be a funnel with an elongated tube, or a modification of it, as shown in Figs. 181, 182, and 183, or one may be improvised by selecting a tube of sufficient diameter to permit of the introduction of a small funnel (see Fig. 184). The object of using a funnel tube is to prevent the soiling of the neck of the retort; as the object of distillation is usually to purify the liquid, the latter must be delivered into the bowl of the retort without touching the neck. Fig. 185 shows the method of charging a plain retort; a small piece of rubber tube is sometimes

Fig. 180



Use of adapter

Fig. 181 Fig. 182 Fig. 183



Stoppered funnel tube — Funnel tube — Thistle top funnel tube

placed on the end of the funnel tube to guide the liquid safely and guard against fracture. Tubulated retorts are charged by simply placing a funnel in the tubulure and pouring the liquid through it.

Safety Tubes.—It is sometimes impossible to avoid sudden evolutions of vapor during distillations. When there is a likelihood of such occurring, it is advisable to insert a Welter's safety tube into

Fig. 184

Improvised funnel tube

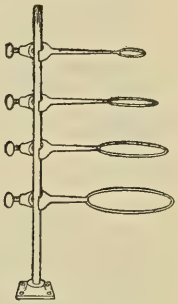
Fig. 185

Charging a plain retort

Fig. 186

Welter's safety tube

Fig. 187

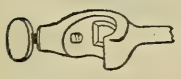


Retort stand

the tubulure of the retort. This tube (see Fig. 186) is bent into the form of an S, having a bulb blown in the middle, and a thistle funnel at the top. Mercury is poured into the tube before inserting it into the tubulure of the retort, and a piece of loose cotton is placed in the thistle funnel; when undue pressure occurs, the mercury is forced into the cotton and the vapor escapes; when the retort has been thus relieved, the mercury descends into the bulb and the distillation proceeds.

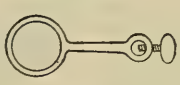
Retort stands are used to properly support retorts, flasks, receivers, etc., during distillation, although they are also employed by pharmacists for a variety of other purposes, as in filtration, percolation, evaporation, etc. Fig. 187 shows a retort stand which has been used with much satisfaction in the laboratory of the Philadelphia College of Pharmacy. It is more substantial than those that are commonly

Fig. 188



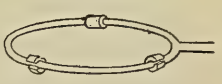
Retort ring clamp

Fig. 189



Retort ring

Fig. 190

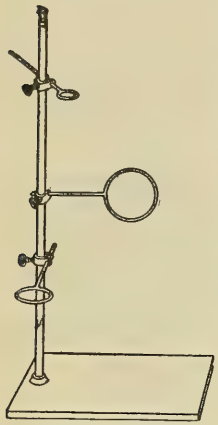


Ring with split sections of rubber tubing

furnished by the chemical apparatus makers. The clamp (see Fig. 188) is made upon the principle of one originally devised by S. Floyd Wiegand, and is hook shaped, so that any of the different sizes of rings may be unscrewed from the upright rod without disturbing the rest. In many of the common retort stands the bottom ring cannot be removed without first slipping off all above it. Fig. 189 shows

the ordinary retort ring. The almost universal fault of the retort stands in common use is their extreme lightness and want of stability; the rings frequently bend under such weights as should be easily borne, and, owing to the base being too light and small, the whole stand is sometimes upset during an operation. In the stand shown in Fig. 187 the base plate is permanently fastened to the operating counter in a place known to be the most convenient; if the counter is one that must be used for other purposes, the base plate may be screwed to the under side of the counter, and a five-eighths inch hole bored through the counter, so that the centre shall coincide with the centre of the hole in the base plate. When the retort stand is not in use, the hole in the counter may be closed with a cork. The upright is made of half-inch iron tubing, and can be quickly screwed into the base plate with the hands without the use of pipe tongs. The rings and clamps

Fig. 191



Apparatus stand

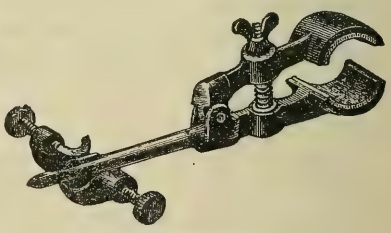
Fig. 192

Apparatus stand (horizontal)

are all in one piece, and are made of malleable iron, so that if dropped on the floor they are not likely to break. When used for holding a glass percolator or funnel, the danger of fracture on account of the contraction of the iron ring may be avoided by stretching three split sections of rubber tubing upon it (see Fig. 190).

An apparatus stand designed by J. Percy Remington is shown in Fig. 191; the clamp is simple and effective; it is U shaped and perforated so as to permit the passage of the rod of the ring freely; the thumb screw is depended upon to firmly fasten the ring upon the upright rod, and the clamping device permits the ring to be placed in any position, pushed in or out, or turned, so that, as often happens in adjusting retorts, flasks, funnels, or percolators, if some slight change in the position of the ring is required, it can be made easily. Fig. 192 shows how the apparatus can be used for a horizontal attachment to be fastened on the wall. Fig. 193 illustrates Bunsen's clamp, which is very useful for holding condensers, retorts, etc.; the jaws of the clamp are lined with cork to serve as non-conductors and protectors against fracture.

Fig. 193

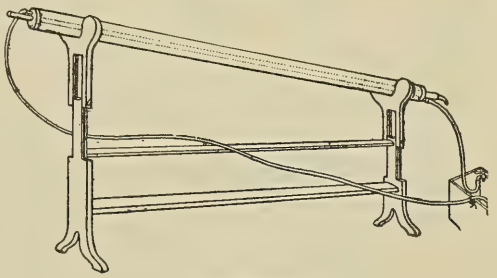


Bunsen's clamp

Bumping is the term applied to a phenomenon occurring when certain liquids are heated to a boiling point in glass vessels. Ebullition often proceeds regularly at first, and the vapor is given off continuously, when suddenly the surface of the liquid will become

smooth for a few seconds. This is succeeded by a slight explosion, when the accumulated vapor is violently expelled and the liquid is said to "bump." These effects occur alternately, and increase as distillation progresses, and some liquids, particularly sulphuric acid, cannot be distilled in glass vessels without using certain precautions. The exact cause of bumping has not yet been satisfactorily explained, but the fact that the forces of cohesion and adhesion in certain liquids are greater when they are boiled in glass vessels than in metallic vessels has been proved. The expedients that have been used to prevent bumping, or rather to lessen its effects, usually consist in the addition of some insoluble solid substance to the liquid, such as broken glass, a fragment of charcoal (when admissible), pieces of clay pipe, rock crystal, etc.; these serve to break the explosive force of the vapor in its upward course, and are thus serviceable. Probably as good an expedient to use as any in pharmaceutical operations, is to add a few pieces of glass of irregular shape to the liquid before it is heated.

Fig. 194



Liebig condenser

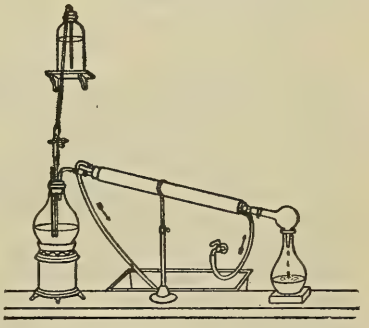
Liebig Condenser

This condenser, although now bearing the name of the great chemist, was used before his time. It consists of a long glass tube, surrounded by another tube of larger diameter; two small openings are made, one near the bottom and the other near the top of the large tube. Connection is made with the tube leading to the bottom with a cold water supply, and the water circulates in the space between the inside of the large tube and the outside of the smaller tube, and finally has its exit at the opening near the top. Fig. 194 shows a large condenser of this form, well suited for illustrating the process of condensation practically. Both tubes are of glass, the ends being of rubber, and made by cutting two sections from a clothes wringer roller; the lowest rubber cork is perforated at its lowest convenient point, for the introduction of a short piece of glass tubing, and the upper rubber cork is similarly perforated for the same purpose. A rubber tube connects the lower

Fig. 195

Liebig condenser (all glass, rubber joints)

Fig. 196



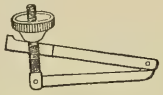
Liebig condenser in use

short glass tube with the cold water supply, while another rubber tube, connected with the upper short tube, carries off the warmed water. For smaller condensers the form shown in Fig. 195 answers very well ; the outer glass tube is contracted at the ends and supplied

Fig. 197

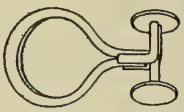
Squibb's pinchcock (open)

Fig. 198



Squibb's pinchcock (closed)

Fig. 199



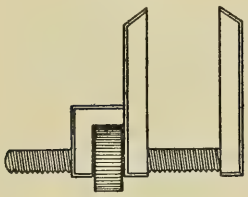
Spring pinchcock (Mohr's)

Fig. 200

Screw pinchcock (Hoffman's)

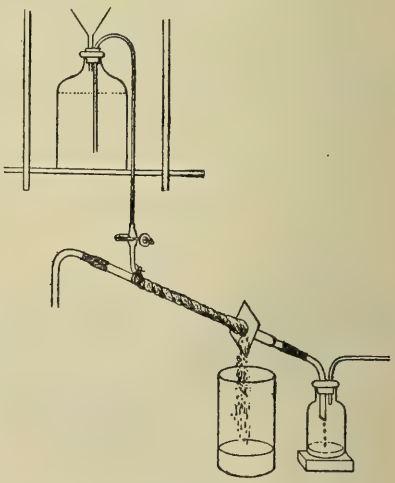
with short tubes as shown, a rubber tube or bladder joint being used to make the joint between the condenser tube and the outer tube. This form is recommended in preference to the kind frequently sold, in which a long and thin glass tube, designed to supply the cold water, is joined to the large tube at right angles. This glass tube is very easily broken off, and the condenser is then useless. If the outer case is of sheet copper and the tubes metallic, this objection is overcome, although the great advantage of using glass tubes, that of being able to watch the process of condensation and of regulating the heat accordingly, is then lost. Fig. 196 shows a glass Liebig condenser in operation, and in addition the method of using a glass tubulated receiver, with a flask to collect the distillate. The liquid which

Fig. 201



Pinchcock (Remington's)

Fig. 202

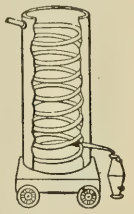


Tube condenser in use

is being distilled is gradually supplied to the distilling flask by the feed tube from the contents of the bottle on the shelf. The rate of flow is controlled by a pinchcock compressing the rubber tube. An enlarged view of the best form of pinchcock to use for this purpose is shown in Figs. 197 and 198. It was contrived by Dr. Squibb to overcome the annoyances experienced in using the ordinary forms. It can be easily and quickly applied to or removed from a rubber tube without breaking a joint, and much more perfect control of the flow can be secured than by the form seen in Fig. 199, which is known as Mohr's. Hoffman's screw pinchcock (see Fig. 200) is often useful, but it cannot be applied or removed so conveniently as

Squibb's. A section of compressed tube is shown at A. Fig. 201 shows a powerful pinchcock designed by J. Percy Remington for use upon large sized rubber tubes. Fig. 202 shows a method of refrigeration which may be used when the ordinary condensers and a steady supply of water are not to be had. A wide tube is connected with the distilling flask, and some lint, lampwick, or other absorbent material is wrapped spirally around it and tied at the ends ; a square piece of cardboard is perforated so that it will fit tightly upon the tube, and it is pushed upon the lower end until it is in close contact with the lint. If water can be supplied from a faucet, a rubber tube is connected with it and conducted to the upper part of the condensing tube, and tied in such a position that a stream of water will trickle from it and be carried down by the lint until it reaches the cardboard, where it falls into the vessel prepared to receive it. If hydrant water is not available, a large bottle containing water may be placed upon a shelf, and a syphon, having a rubber tube and pinchcock, attached, as shown in the cut.

Fig. 203



Condensing worm

The Condensing Worm.—The method of condensing by the use of the worm is very old, and its advantage in securing economy of space and its ease of application are very apparent. Fig. 203 affords a good illustration of this kind of condenser used in the larger laboratories. It will be found most convenient to attach the condenser to a wooden base, mounted on wheels, of suitable height. This permits the convenient shifting of the condenser to the different stills. Block tin pipe is the best that can be used for general pharmaceutical work. Copper or tinned copper tube should be avoided, because it is impossible to prevent the action of acid vapors or liquids upon the copper. Soluble salts of copper would thus be formed and the distillate often rendered poisonous. Iron tube is not admissible, on account of the contamination from iron salts. Pure tin is not affected so easily, and the salts that possibly would be formed are not so objectionable. Block tin pipe may be wound spirally around a convenient cylindrical vessel, such as a tin can or similar object, to give it the proper shape, and then fastened to three notched uprights and placed in position. Earthenware condensing worms of all sizes, of excellent quality, are made by Doulton & Watts, Lambeth, London, England, and by John Cliff & Sons, Leeds, England ; they are also made in this country. For condensing acid vapors, as in the making of spirit of nitrous ether by distillation, these condensers are undoubtedly superior to metallic ones.

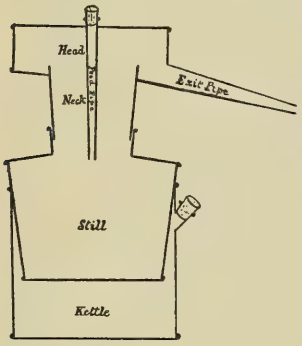
Pharmaceutical Stills

Stills are preferred in all distillatory operations where the liquids or vapors do not act chemically upon the metals of which they are made. Tinned copper is the best material to use in the construction of stills, for, although tinned iron is cheaper, the greater durability of the former renders them in the end more economical. The same typical forms may be seen in the construction of pharmaceutical stills as in glass distillatory apparatus,—*i.e.*, the alembic and retort.

Pharmaceutical Stills—Alembic Principle.—One of the most useful stills constructed on this principle was devised by Prof. Procter.

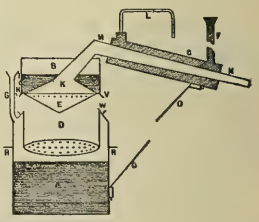
The still body was connected with the condensing head or dome by a water joint, and the sides of the dome were continued up into the head so that an alembic gutter was formed to catch the condensed liquid; this was delivered at the spout, and this spout was partly surrounded by the jacket. Water for refrigeration was supplied by a tube; this first circulated around the delivery spout, and then found an exit through a rubber tube. Wiegand's still is shown in Fig. 204. It differs from Procter's principally in the method of joining the head of the still to the body; the sides of the head are tapering, so that the head can be pressed down tightly into the body, and with the aid of flaxseed lute a tight joint can be made; the feed pipe is useful in charging the still, from the fact that it carries the liquid below the point where it would be likely to soil the condensing surface by splashing. Prof. Curtman's still (see Fig. 205) has several modifications about it which require special notice. The jacketing of the neck of the alembic, which is partially carried out in Procter's and Wiegand's stills, is extended so that it is converted into a Liebig condenser; a bent tube, L (see Fig. 205), serves to convey water partially heated from contact with the vapor over into the head, B. This modification is especially intended to strengthen alcohol which is in process of recovery from weak tinctures; the water used for refrigeration circulates around the central tube, N, in the Liebig's condenser, and then finds an outlet into the head B by means of the bent tube L. The intention is to regulate the flow of water so that it shall be sufficient to condense alcoholic vapor passing through the tube, the heated water from L being at the same time of a temperature just above that of the boiling point of alcohol (180° F.). The vapor of water coming over with the alcoholic vapor comes in contact with this heated surface, and, as the boiling point of water is 100° C. (212° F.), the temperature of the condensing surface (180° F.) is sufficient to condense the vapor of the water, but not that of the alcohol; thus the water is separated and trickles back into the still, while the alcoholic vapor passes on into the condenser.

FIG. 204



Wiegand's still

FIG. 205

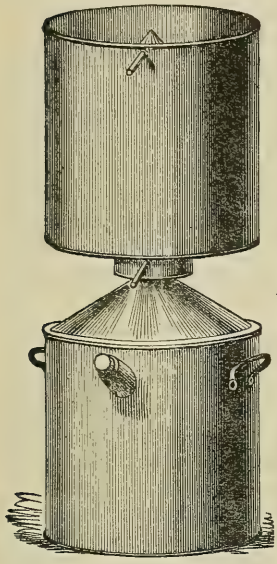


Curtman's still

A still on the alembic principle, made by the Whitall Tatum Company, is shown in Figs. 206 and 207. E represents the boiler, the pan C being used as a water bath if required. The vapor rises through the tube H and passes into the chamber B, where it is condensed. The reservoir A is supplied with cold water, ice, or snow. The condensed liquid flows into a trough around the tube H and is discharged through F. At G there is a tubulure, closed with a screw cap, through which the boiler can be supplied with water or the liquid

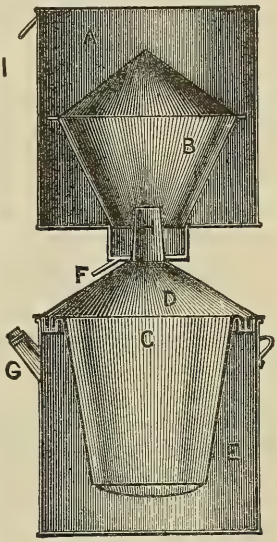
which is to be distilled. The reservoir A is furnished with an overflow pipe to conduct away the warm water as distillation proceeds. The still is simple in construction, but in practice it will be found advisable to attach a rubber tube to F to conduct the distillate away from the flame or other source of heat.

Fig. 206



Pharmaceutical still

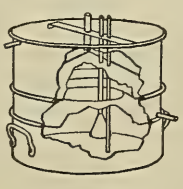
Fig. 207



Pharmaceutical still

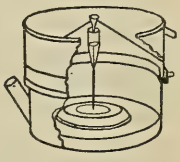
Fig. 208 represents Game's still, made by J. M. Maris & Co., of Philadelphia. This still is also constructed on the alembic principle, the special features being the tubes, as shown in the drawing, which are used to supply the still with liquid continuously during the distillation. One of the tubes connects with the reservoir and furnishes air to replace the liquid as it flows into the still; in the distilling chamber one of the pipes is shown descending nearly to the bottom of the still; one of the pipes terminates in an inverted funnel near the bottom for the purpose of lessening the possibility of the air pipe becoming closed by the splashing of a thick liquid. The mouth of this cone is about three-fourths of an inch above the bottom, and it will be seen that when sufficient liquid has been run into the still from the supplying tube to reach the bottom of the funnel tube, no more liquid falls from the reservoir, and thus the amount of liquid in the still is always limited. When the distillation reduces the quantity of liquid so that it falls below the level of the funnel tube, the liquid runs again from the reservoir, and thus the supply becomes automatic. The other parts of the still will be readily comprehended by inspecting Fig. 208.

Fig. 208



Game's still

Fig. 209



Stevens's still

The still shown in Fig. 209 was invented by Prof. A. B. Stevens, of Ann Arbor, Michigan. As will be seen from the illustration, it is made on the alembic principle, but it has several features about it which differ from the stills heretofore described. A light copper float, having a central rod or stem, is arranged in the still body, so that it will warn the operator when the liquid in the still has evapo-

rated below the danger point, previously adjusted. One of the best features about this still is the method of joining the two principal parts. The water joint, which is never satisfactory in actual practice, is replaced here by a rubber rod ring, which fits into a circular groove and is held in place by clamps which are easily disconnected when the distillation is over. The methods of conducting and refrigerating are similar to those indicated in the preceding descriptions of alembic stills.

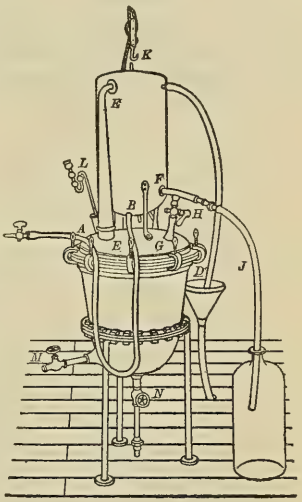
Stills constructed on the alembic principle have the disadvantage of having the cold water supply directly over the source of heat, and, as the latter is usually a coal stove or gas burner, the cold water used for refrigeration is rapidly heated, and much more is required to effect condensation than is the case with stills constructed on the retort principle. Again, the delivery tube of the condensed liquid is immediately over the fire, and in recovering alcohol from weak percolates (one of the principal uses of pharmaceutical stills) the danger from alcoholic vapor taking fire is great, if constant vigilance is not exercised. Many accidents have occurred through the neglect of the operator to keep a constant supply of cold water applied to the condenser. In cities and towns where water is supplied by a tap or faucet the flow is sometimes stopped by the shutting off of the water when workmen are making repairs to the pipes, and serious accidents are thus likely to occur through the water in the condenser becoming so hot that it will not condense alcoholic or ethereal vapors, which soon come in contact with the flame, and fire or explosion results. In all stills made on the alembic principle care should be observed to connect a metal or glass tube with the delivery tube of the still, so as to lengthen it and convey the condensed liquid as far as possible away from the flame. Fortunately, water joints are now rarely employed. These usually consist of a gutter running around the top of the still body and filled with water; the head of the still is simply laid on top and held in place by a clamp; in a short time the heat evaporates the water, permitting the escape of vapor; hence watchfulness is required to renew the supply of water.

The distilling apparatus known as the Prentiss still, or alcohol reclaimer, possesses some peculiarities, a portion of the vapors being condensed immediately over the still. The still body has an upright column screwed to it; this connects by a union joint with the condenser, which is a single pipe bent into a zigzag form and terminating in a spout. The water intended for refrigeration is poured into the funnel at the top. The distinctive feature, however, is the series of perforated diaphragms which are soldered to a central rod and are placed inside of the column; these are asserted to impede the passage of and condense aqueous vapor when mixed with that which is alcoholic; the alcoholic vapor passes over and is converted into alcohol in the condenser, while the condensed water falls back into the still.

A condenser contrived by Charles Rice, in which the block tin worm is enclosed and placed immediately above the still head, is shown in Fig. 210. The still is heated by steam, which enters at *M*, *N* being the exhaust pipe. The still head is constructed of copper. The condenser is a cylindrical copper vessel, with rounded bottom and

closed top, having short half-inch tubes projecting from the bottom and from the top at *B* and *C*. There are two such tubes at the bottom, one for attaching the rubber hose, *A*, bringing the water; the second, shown in the cut immediately alongside the letter *B*, is closed with a cork, and is used to permit the water to be emptied without detaching the hose from the other. At the top there are two tubes, one at *C* for attaching rubber hose to carry off the water into the wastepipe *D*; the other, which is closed with a cork, is not shown in the cut, as it is on the back of the condenser.

Fig. 210



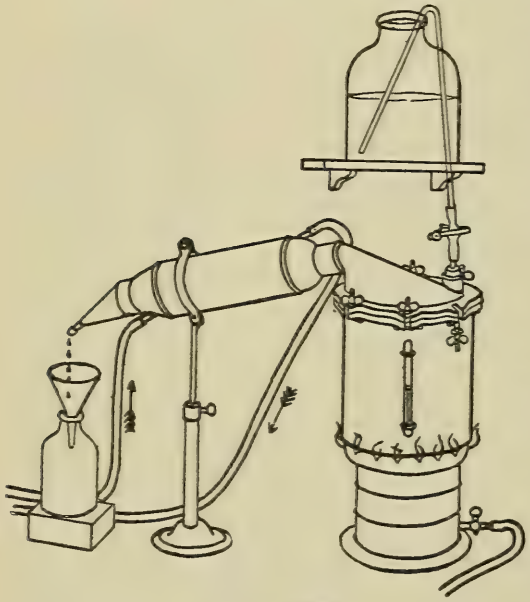
Rice's still and condenser

The head of the still carries three short tubulures, only one of which is visible in the cut. This one contains a cork bearing the safety valve, *L*. A second one is at the other side, for refilling the still when required, with another narrower tube intended for the insertion of a thermometer. The condensing pipe begins at *E*, where it rises from the head parallel with the condenser. It is made of copper as far as the point indicated by the upper *E*, where it is soldered to the *downward projecting* upper end of the block tin worm contained in the condenser and emerging from it at *F*. This arrangement makes it impossible for any condensed liquid to come in contact with anything but block tin. The worm inside the condenser is made by carefully winding block tin pipe upon a round block of wood, taking particular care to give the coil a uniform downward descent throughout. After emerging from the condenser at *F*, it extends for a short distance, where the cut shows it to be connected to the separate block tin pipe, *J*, by means of a union joint lined with tin. Half way between *F* and the end proper of the worm the pipe is tapped, and a branch, carrying the faucet *H*, leads into the still at G, where it terminates under the centre of the head in the form of an S, forming a trap to prevent the escape of vapors by this passage. The object of this arrangement is to cause the condensed liquid to flow back into the still as long as the faucet *H* is open, or to collect it outside by turning off the faucet. Prolonged digestions with alcohol may be made by means of this apparatus without any loss of liquid. The head is attached to the still by means of a rubber washer and iron clamps, and when it is desired to remove it the water is allowed to drain from the condenser, the clamps are taken off, and the whole is hoisted up by the tackle *K*, and moved aside.

Pharmaceutical Stills—Retort Principle.—The method of condensing vapors by cooling them in a separate vessel connected with the still by a tube or tubes has been largely employed. The simplest plan is to connect the still head with a Liebig condenser or a worm. The principal disadvantage of the former method is that considerable space is required in providing for the long tube and its refrigeration, and this

is an important consideration in most laboratories. The disadvantage about the worm is one which is still greater, for, while space is economized, the spiral shape of the worm prevents the possibility of thoroughly cleaning it, and where a still is used for several purposes the odor and taste of the last liquid used in the still will be very apt to pervade and contaminate the distillate in process of collection. Kolle, in his endeavor to overcome these objections, retained the condensing tub, but, instead of using a worm, bent the pipe into a zigzag form and adjusted it in a vertical plane, the angles of the zigzag tube upon one side projecting through the sides of the tub. These projecting angles were made of separate, short pieces of tube, which were cemented to the condensing pipe. The objection to this condenser was the inconvenience of breaking and making so many joints. Mitscherlich improved Gadda's condenser by constructing a condenser from two cylindrical vessels, the inner one removable and yet capable of being connected with the outer vessel by a tight joint. Deficiency of condensing surface and the inconvenience of making vapor tight joints were objectionable in this condenser.

FIG. 211



Remington still

From a consideration of the necessity for some new plan for condensing liquids in pharmaceutical stills, whereby the above objections could be overcome, the author was led, in 1872, to employ the principle of the tubular boiler for condensation (see Fig. 211). The body of the still is made of tinned copper; the bottom is not rounded, but flat, permitting it to stand securely on an ordinary counter; the bottom is made of heavier copper than the sides, and is fastened by tucking and folding, thus making a tight joint. A glass tube water level on the side of the still shows when the liquid has been distilled to a dangerously low point, as well as heated to active ebullition, which may result in frothing. The glass tube may be removed from the lower connection by simply unscrewing the cap, and if a thick residue in the still remains, it may be transferred to a bottle or dish by allowing it to escape at the lower tube orifice, thus avoiding loss of product by waste. The still body is connected with the top by a "twine joint," a flat brass ring being soldered to the top of the still

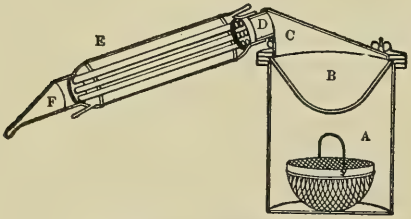
body, and another of exactly the same size being soldered to the still top or dome. When the connection is to be made, a piece of soft, thick twine, two inches longer than the circumference of the ring, is soaked in water, and carefully laid upon the brass ring in such a way that the ends overlap ; the top is then carefully laid upon the wet twine and securely fastened with clamps, which should be applied at opposite points at the same time, so as to bear equally. The new form of hinged clamps is shown in Fig. 211. They are fastened to the ring and cannot be mislaid, a disadvantage of the old form of clamps.

The *still top* differs from most others in having the opening for the escape of vapors drawn over to one side, instead of in the centre ; by this arrangement the condensing surface of the dome is reduced to a minimum, and condensation *inside the still* is obviated as far as possible.

The construction of the condenser shows the application of a well known principle which has been made to do service for an opposite purpose. The substitution of a number of tubes of small diameter for one large vessel is recognized as an effective means of rapidly producing vaporization (see page 143). The principle is of equal value in condensation. The condenser has seven parallel, solid block tin tubes, surrounded by a copper case. This case is perforated twice, and a short tube is soldered in at each extremity. To the lower tube a rubber tube is attached, which is connected with a cold water faucet ; a rubber tube is slipped over the upper short copper tube of the condenser for carrying off the water after it has served its purpose of condensing the vapors, which it does by circulating freely between the outer surface of the block tin tubes and the inner surface of the containing case. The proportions of this condenser are so adjusted that if any liquid likely to be used is actively boiled in the still body, and cold water is running through the condenser, there can be no escape of condensable vapor at the exit tube. In the condenser for the still holding three gallons the combined length of the tubes is about six feet, and about one hundred square inches of condensing surface are obtained. The condenser itself is fifteen inches long and about four inches wide. Straight, smooth, solid block tin parallel tubes are used because of the convenience of cleaning them. A piece of cloth wrapped on the end of a rattan or stiff wire may be rapidly pushed through each tube, which serves to clean it when a very odorous liquid has been distilled, but usually it suffices to hold the condenser under a hot water faucet for a few moments. The methods of connecting the various parts of the apparatus are simple. Two ground brass joints are made, one at the point of junction of the condenser, with the still head top, and the other where the nose piece is attached to the end of the condenser. These, on account of their comparatively small diameter, require no clamps or lute, and are vapor tight. Where a moderate heat below the boiling point of water is required the still body is placed in a kettle ; and, if the quantity of liquid to be distilled is not large, a round bottomed, tinned copper water bath is clamped between the still body and still head, and the still body filled with water, the waste steam escaping through three apertures in the rim of the water bath. This water bath arrangement may be used in

addition in making ointments. The automatic feeding attachment consists of a glass syphon, a rubber and a glass tube (the latter passing through a cork), and a pinchcock. The manner of using this is as follows: The still having been charged (about half full), the remainder of the liquid is placed in a vessel above the still body upon any suitable support; the syphon is placed in the liquid, then connected with the rubber tube carrying the pinchcock, and by suction or other means the syphon is filled and the pinchcock screwed down; the other end of the rubber tube is then connected with the glass tube running through the cork, which passes through the tubulure in the still head. Heat is now applied to the still body, the cold water faucet is turned on to supply the condenser with cold water through the lower rubber tube, and when the distillate comes over in a steady stream a narrow strip of paper is pasted on the glass gauge tube on the body of the still to mark the level of the liquid at starting. The pinchcock is then opened, and the level of the liquid in the still is regulated so that the liquid neither rises nor falls. This indicates that a stream of liquid from the reservoir above is running into the still exactly equal in volume to that of the distillate running from the exit tube, and the apparatus may be left to take care of itself. The empyreumatic odor which distilled and aromatic waters often possess, and which is usually caused by the solid substances lying in immediate contact with the hot still bottom, is obviated in this still by putting the substance into a hemispherical, coarse wire sieve cage (see Fig. 213). The round bottom of the cage prevents any possibility of contact with the flat bottom of the still, while circulation of the water

FIG. 212



Remington still (sectional view)

FIG. 213

Wire cage

and vapor takes place through the meshes; a handle serves to lift it out when the distillation is completed. Fig. 212 also shows a dissected view of the still, which illustrates the relative position of the parts,—A, the still body; B, water bath; C, the still top, or dome; D, joint; E, condenser; F, exit tube for distillate.

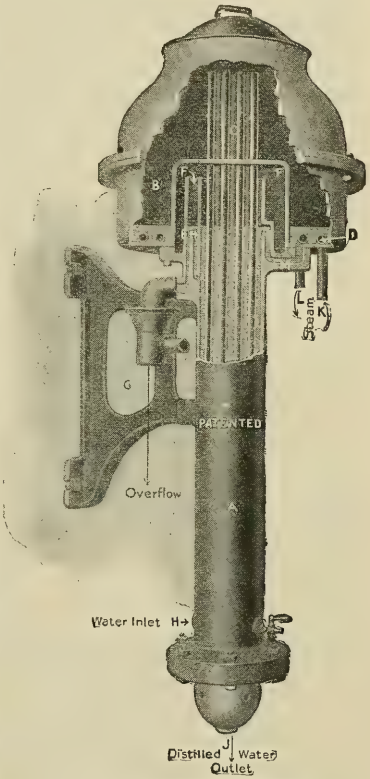
Owing to the necessity for using distilled water in pharmaceutical operations, and to the widespread agitation in the public print on the subject of impure water in cities, distilled water has become an important product, and pharmacists in some localities use a water still constantly for supplying the demand. This has stimulated the manufacture of water stills, and a number of such are to be found on the market.

One of these stills, illustrated in Fig. 214, is made by the F. J. Stokes Company of Philadelphia and may be obtained in various sizes and styles with a capacity of from one-half gallon to one hundred gallons

per hour. Gas, gasoline, or live steam may be used to supply the heat. The principle upon which they operate is as follows: The feed or raw water enters at (H), surrounds the condenser tube (C) and serves first to condense the steam generated in the still (B) as it descends the condenser tubes, converting it into distilled water. In so doing the raw water becomes heated to the boiling point by the time it reaches the top of the condenser where the ammonia and other gases escape into the air through the opening (F). A part of this feed water escapes over the goose-neck (E), either into a waste pipe or cistern, and the balance passes into the still through the passage (M).

In the illustration, it will be seen that there is a zone of water at the top of the condenser, which being above the outlet to the overflow (G), is not drawn off except to replenish the water in the still as it evaporates. This zone of water at the top of the condenser is constantly kept boiling by the steam from the still descending the condenser tubes, and it is here the ammonia and other gases are liberated. The still in the illustration is heated by live steam with a pressure of twenty pounds or over, which circulates in the copper coil (D), and serves to boil or evaporate the raw water. The distilled water comes out at (J) and can be piped to any receptacle. The condenser tubes extend to the extreme top of the steam chamber and high above the water level, so there is no danger of water being carried over by steam.

FIG. 214



Stokes' Automatic Water Still.

Fractional Distillation.—By this term is meant the process of separating by distillation liquids having different boiling points or vapor densities. When a mixed liquid, or one consisting of liquids of unequal volatility, is distilled, the first portion of the distillate contains a larger proportion of the most volatile constituent than of the others; hence the boiling point is observed to rise as the distillation proceeds; and if a means is provided for collecting the distillate in several portions, or fractions, as they are called, fractional distillation offers a process by which liquids may be purified or separated. It is impossible, however, *in a single operation* to effect this separation of the component parts of a mixed liquid perfectly, because the distillate obtained at any period of the process is nearly identical with the vapor that is rising from the hot liquid, and therefore it is made up of the condensed vapor of that part of the liquid having a boiling point at or below the tem-

perature registered by the thermometer, plus the smaller amount of condensed vapor that is given off from the constituents having higher boiling points, but which emit sensible vapors much below the point at which they actively boil. The relative proportions of the constituents of the mixed liquids have also a bearing in determining the composition of the distillate. By collecting the fractions carefully at stated temperatures, and redistilling each by itself, a more thorough separation may be effected, and this method is usually followed when such a separation is necessary. Upon the small scale one of the simplest forms of apparatus for fractional distillation is made by taking a gas bulb (a glass flask having a bent lateral tube in the neck), and, having adjusted a perforated cork in the neck for a thermometer, passing the tube of the gas bulb into a loosely stoppered test tube, which is placed in a vessel surrounded with ice or properly refrigerated. A more efficient method is to connect the lateral ascending tube of a flask with the end of a worm, or a condenser so arranged that the liquid condensed at a certain temperature may run back into the flask. Vapors having lower boiling points pass through it uncondensed until they reach the second condenser, which is refrigerated to a degree sufficient to condense all the vapor. This method is used for manufacturing purposes upon the large scale.

Destructive distillation is the process of heating dry organic matter in a distillatory apparatus until all volatile substances are driven over. The residue is said to be carbonized. Destructive distillation is a process which is rarely employed by the pharmacist; hence it is not necessary in this work to treat the subject in detail. Glass vessels are not adapted to the process, because they will not usually stand the heat required without fracture, and the solid residue frequently fuses, is insoluble in water, and becomes so firmly attached to the bottom and sides that it cannot be removed without great difficulty. The best form of apparatus is an open vessel of cast iron, like a crucible, having a flange at the top, a dome with a corresponding flange, and a bent tube for carrying off the gaseous products. The connection is made with fireclay lute and iron clamps. The manufacture of acetic acid, creosote, methyl alcohol, etc., affords illustrations of the use of this process, which is nearly always performed on a large scale.

The application of the process of destructive distillation to wood results in the production of many valuable products, as acetone, methyl alcohol, methyl ether, acetic acid, creosote, tar, etc., while charcoal remains in the still. When applied to coal the distillate yields illuminating gas, ammonia products, coal tar, from which is obtained numerous phenol bodies, cresols, benzene, toluol, dye color bases, etc., coke remaining in the still.

The distillate from this operation represents a decomposition product,—*i.e.*, a substance which did not exist in the original matter placed in the still, but which results from the application of heat without the presence of air. A characteristic smoky odor, called empyreuma, is usually recognized in the distillate but may be removed by purification.

CHAPTER VI

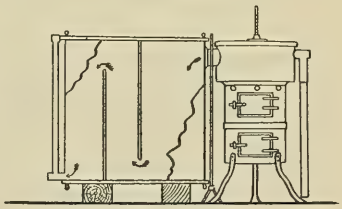
SUBLIMATION

SUBLIMATION is the process of distilling *volatile solids.* The product is termed a *sublimate.*

The objects of sublimation are as follows: 1. To purify volatile solids from admixed and fixed impurities. 2. To provide a convenient means of collecting volatile solids resulting from chemical reaction at high temperatures. The retorts or apparatus used may either be of iron or glass, or of stoneware if the degree of heat necessary will admit of the use of the latter.

Sublimation is almost exclusively confined to operations which are conducted by manufacturers on the large scale. A process was formerly official for the sublimation of benzoic acid. It consisted in introducing benzoin into a shallow tinned iron pan, and pasting over the top a sheet of filtering paper. A pasteboard hood, shaped like a hat box, was then fitted to the pan and tied or pasted with paper so that a tight joint was made. The apparatus was placed on an iron plate and subjected to a low but *uniform* heat. The vapors of benzoic acid passed through the pores of the filtering paper, were separated from impurities, and, coming in contact with a cooler atmosphere in the hood, slowly condensed, often forming crystals of great beauty.

FIG. 215

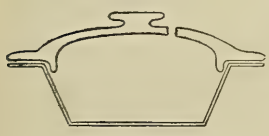


Sublimation of benzoic acid

Fig. 215 illustrates Hager's apparatus for subliming benzoic acid. The stove is shown on the right; upon the top is placed the vessel containing a mixture of benzoin and sand. A pipe enters this vessel at the upper part from the right; through this a regulated current of air is forced after the mixture has been slowly heated, and the vapors of benzoic acid are driven, as shown by the arrows, into the large chamber, where they condense and the crystals collect upon the partitions and floor.

The temperature at which the condensation of the vapor is effected in sublimation has a very important influence in determining the physical character of the sublimate, and two kinds of sublimates are produced,—1. Cake sublimates. 2. Powder sublimates.

FIG. 216



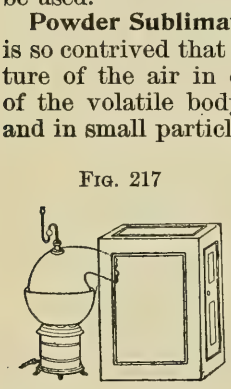
Subliming apparatus (cake)

Cake Sublimates.—If the temperature of the condensing surface and of the air in contact is but slightly below that at which the volatile body is capable of subliming, the particles will be deposited in compact masses, like corrosive sublimate, commercial sal ammoniac, or ammonium carbonate. Fig. 216 shows a simple apparatus for obtaining sublimates in cakes or masses. A shallow sheet

iron dish, having its upper edge turned out so that it forms a flat ring, is provided with an earthenware cover (it will be usually found more convenient to have the iron dish made to fit the cover than the reverse), through which a hole is drilled to permit the escape of air (this may be done with a three cornered file). After the substance which is to be sublimed has been placed in the iron dish, a piece of asbestos twine, slightly longer than the circumference of the ring, is laid upon it, and this is covered with a lute composed of equal parts of potters' clay and flaxseed meal with sufficient water, the earthenware cover is pressed upon it until it adheres, and, when necessary, iron clamps are used to make a tight joint. The aperture in the cover is loosely covered with a cone of cardboard, the dish is placed in a sand bath and gradually heated. The aperture is kept open during the sublimation by occasionally probing it with a glass rod. After cooling, the sublimate will be found adhering to the earthenware top in one cake or mass, and may be removed by a spatula. The earthenware top may be replaced by a sheet iron one in cases in which the former would be likely to be fractured by excessive heat. For subliming iodine, earthenware vessels alone should be used.

Powder Sublimates.—If the apparatus for conducting sublimation is so contrived that there is a marked difference between the temperature of the air in contact with the vapor and the subliming point of the volatile body, the sublimate will be deposited very rapidly and in small particles, like calomel, sulphur, etc.

FIG. 217



Subliming apparatus (powder)

Fig. 217 shows a convenient apparatus for subliming camphor in powder. It is well adapted also for a lecture room illustration of the process. A wooden case has two openings made in the sides to admit sheets of glass, which are secured in place by putty in the usual manner. One of the sides has a hinged door, which fits the frame snugly; the opposite side has a tapering circular aperture, which admits the shortened beak of a retort, as shown in the cut. Camphor is placed in the retort, a safety tube is adjusted in the tubulure, and the retort is then placed deeply in a sand bath on a good gas stove. Care must be observed in heating at first, and a Bunsen burner should be at hand to heat occasionally those portions of the top of the retort and the beak upon which the sublimate is forming. When the boiling point is reached, the camphor vapor passes over rapidly, and at once falls in the form of powder upon coming in contact with the cold air in the chamber. The especial points to be observed are care in heating, and watchfulness that the beak of the retort does not become clogged with the sublimate. A judicious use of the Bunsen flame will soon melt the obstruction.

The most important, and in practice the most difficult, part of the operation of sublimation is the regulation of the heat. The temperature of the condensing surface should always be below the fusing point of the substance if distinct crystals or crusts are expected.

QUESTIONS ON DISTILLATION AND SUBLIMATION

What are the elements of distillation? (See page 160.)
How many times its weight of water at 20° C. (68° F.) are required to condense steam at 100° C. (212° F.)?
What two forms of apparatus are used in distillation?
What is the form of an alembic?
What is the body of it called? What is the form of a retort?
Has a retort any advantages over an alembic, and if so, what are they?
What is a plain retort? What is a tubulated retort?
Of what materials are retorts made?
For what purposes are the various kinds used?
What are the essential qualities of a good retort?
What are the advantages of using a flask for distillation?
What is the best shape for a flask?
How may glass tubes be cut? How may glass tubes be bent?
What is a cork borer, and how is it used?
How may rubber stoppers be cut?
What is the advantage of rubber stoppers?
What substitute for rubber stoppers may be made?
How may a satisfactory lute for closing joints be made?
How may bladder be used to join tubes?
How may paper be used to join tubes?
Is rubber superior to bladder for such purposes? If so, why? How is it used?
What are receivers?
What are tubulated and quilled receivers?
What are adapters, and how are they used?
How may plain retorts be charged?
What is a Welter's safety tube?
For what purposes are retort stands used?
How may funnels or percolators be protected from the breakage due to contact with the iron rings of the ordinary retort stand?
What is meant by bumping in distillation?
How may it be prevented or lessened?
What is a Liebig condenser?
Describe the pinchcock contrived by Dr. Squibb.
Describe Mohr's spring pinchcock. Describe Hoffman's screw pinchcock.
How may vapors be condensed when the ordinary condensers and a steady supply of water are not at hand?
What is a condensing worm?
What is the best metal to use for making it?
What objection is there to copper? What objection is there to iron?
What objection is there to tinned iron? What objection is there to earthenware?
What is the best material to use for pharmaceutical stills?
Describe Procter's still. Describe Wiegand's still. Describe Curtman's still.
Describe the still made by Whitall Tatum Company.
Describe Game's still. Describe Stevens's still. Describe Prentiss's still.
Describe Rice's still and condenser.
What is the disadvantage of Liebig's condenser?
What is the disadvantage of a worm condenser?
Describe Remington's still and condenser.
Describe the Stokes' water still. What are its advantages?
What is meant by fractional distillation?
What is meant by destructive distillation?
What objection is there to using glass vessels in destructive distillation?
Give examples of products made by destructive distillation.
What is sublimation? (See page 181.) What is the product called?
What are the objects of sublimation?
Of what material are the retorts or apparatus usually made?
What effect does the temperature of the condensation point of the vapors of solids have upon the character of the sublimate?
What is the difference between a cake sublimate and a powder sublimate?
How are cake sublimates obtained? How are powder sublimates obtained?
What is the most important point to be observed in the operation of sublimation?

CHAPTER VII

DESICCATION

DESICCATION is the process of depriving solid substances of moisture, and in pharmacy should be effected at as low temperatures as possible. (See Exsiccation.)

The objects of desiccating medicinal substances are threefold: 1. To aid in their preservation. 2. To reduce their bulk. 3. To facilitate their comminution.

1. To Aid in Preservation.—Chemical salts frequently contain water either chemically or mechanically combined with them. An elevation in the temperature, or the absorption of water from moisture present in the air, will in some instances cause *deliquescence*, while in others contact with a dry atmosphere will cause *efflorescence*, due to the evaporation of chemically combined water; hence such salts in their natural condition are unstable; they are much more permanent when dried. Vegetable drugs soon decompose or become mouldy if allowed to remain in a moist condition, and desiccation is absolutely necessary to preserve them.

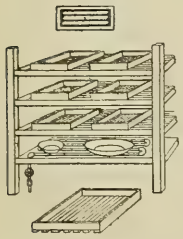
2. To Reduce Bulk.—If desiccation is performed successfully,—*i.e.*, at properly regulated temperatures under certain precautions,—the substance is merely deprived of water without suffering any loss of medicinal activity, and the reduction in bulk that follows is a practical advantage which results in adding to the strength of the medicinal substance.

3. To Facilitate Comminution.—The presence of water gives to drugs an elasticity and ability to resist disintegration, which in some cases interfere greatly with the process of bruising, grinding, or reducing the drugs to particles. One of the first steps in comminution is to dry the substance thoroughly in order to make it brittle or crisp.

The apparatus employed in desiccation is frequently of the simplest character, and the heat is usually not especially created for the purpose, for it is most economical to use the waste heat from kitchen fires or cellar furnaces or the diffused heat in lofts or unused attics. There can be no objection to this if care is taken to provide protection for the substance from dust, light, and injury during desiccation. Herbs may be dried by tying them in bunches and suspending them to the attic ceiling or to the rafters of a barn during summer weather, and this is an excellent method usually, notwithstanding its slowness, because there is no danger of the heat being strong enough to cause loss of valuable volatile principles. Roots, barks, and leaves may be dried by spreading them out upon clean tables or floors in a dry room and turning them repeatedly, so as to expose fresh surfaces

to the dry air. On the large scale, and in the laboratory, special apparatus must be employed. Fig. 218 illustrates a portion of the interior of a laboratory drying room. Live steam is passed through the pipes when higher temperatures are needed, but waste or exhaust steam from steam kettles is economically and properly used. Trays of suitable size, containing the substance to be dried placed on thin muslin, are set upon the shelves of the rack. Ventilators should be provided to carry off the moist air. The space immediately over the steam boiler can often be economically used for a drying room by placing a sheet iron floor over it to secure the radiated heat, and arranging racks and trays upon it in convenient positions, or by placing the drugs in barrels in which the heads have been replaced by wire netting, or by simply enclosing the drugs in coarse bags which permit the escape of moisture.

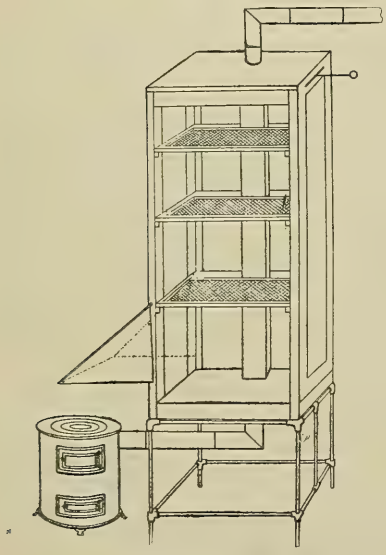
Fig. 218



Desiccating frame and trays

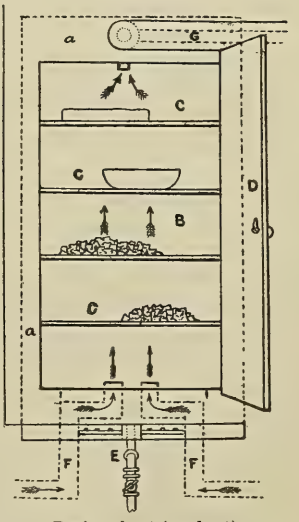
Fig. 219 shows a pharmaceutical drying closet which is simple, economical, and easily made. The heat from the flue of a pharmaceutical stove (see Fig. 65) is utilized. The frame which supports the closet is made of half-inch steam pipe, and to the uprights the retort rings (see Fig. 187) may be clamped, and the filtration of chilled oils in winter time, or warm filtration or percolation of many

Fig. 219



Pharmaceutical drying closet

Fig. 220



Drying closet (gas heat)

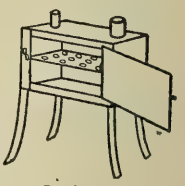
kinds, may be carried on. The sides of the closet are of galvanized sheet iron or of asbestos cloth, tacked to a wooden frame, and cleats at convenient intervals are arranged for the trays to slide upon. The stovepipe from the stove is connected with the flue at the bottom of the drying closet, and the heat from the smoke and gas passing up the

flue is thus utilized ; the hood may be dropped over the top of the stove when the latter is not needed for other purposes, the heated air carrying the moisture from the substance to be dried, rising and escaping at the ventilators. Lozenges, crystallized salts, extracts, filters, etc., may all be dried in this cheap and simple closet. One practical point about desiccation is frequently overlooked. It is that substances which are being dried must be repeatedly turned over, so that the parts underneath shall be exposed to the external dry atmosphere. In the case of salts, crystals, and other bodies, if this is not done, a hard crust is formed upon the surface which is often difficult to break up.

A convenient drying closet, suitable for a small laboratory, is shown in Fig. 220. It was contrived by T. Edward Greenish, of London ; it is heated by gas, and is intended to fit into a recess in the wall. The drying closet, B, is made of thin sheet iron, and provided with wire shelves, C, and a tightly fitting door, D. The closet is made of such a size that when fixed into the recess in the wall a space of about two inches is left at the back, sides, bottom, and top, the space being covered in front by the flanges *a*, *a* ; these constitute, with the door, the front of the closet. E is a gas burner supplied from the pipe, and F, F are two air pipes which enter at the bottom of the closet. These pipes draw their supply of air from an *external* source, and thus the laboratory fumes and odors cannot taint the substances which are to be desiccated. The upper ends of these tubes are covered with a layer of sand two inches deep, forming a sand bath.

The gas being lighted is supplied with air from the front, and the heated air, together with the products of combustion, passes around the closet through openings made for that purpose in the sides and back of the gas chamber, up the space between the closet and the wall to a pipe, G, and thence to a chimney. The substances to be dried, or the liquids to be evaporated, are placed either upon the shelves or upon the sand bath. The air which enters by the pipes F, F, slightly warmed by the sand, will carry up any vapor therefrom to a pipe at the top of the closet, and thence to the pipe G. In order to regulate the draught of air at the back and sides of the closet, and thereby to adjust the degree of heat, the pipe G is provided with a circular damper, and the gas chamber also has in front of it an arrangement for regulating the supply of air to the gas, thus preventing sudden fluctuations of temperature. By these means the heat of the closet may be readily adjusted. If the temperature of the upper shelf is 82° F., the next lower will be 85° F., the next 88° F., the lower one 92° F., while the sand bath will register about 130° F.

Fig. 221



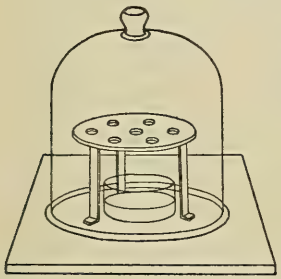
Drying oven

A drying oven, intended for drying precipitates in analytical work, but very useful for desiccating small quantities of pharmaceutical substances, pills, lozenges, or drugs like squill, saffron, Castile soap, etc., is shown in Fig. 221. Water is poured into the tubulure at the top of the jacketed copper case, and a Bunsen burner furnishes the requisite heat when placed so that the flame touches the under surface, the legs of the oven being long enough to permit its use.

In Fig. 222 is shown a desiccator for use in finer laboratory operations. It consists of a bell glass having a ground rim fitting closely to a ground glass plate, a perforated porcelain dish is placed upon a tripod to hold the material to be dried, and underneath is placed a glass dish to hold sulphuric acid or other substance intended to absorb the moisture.

Loss in drying Medicinal Substances.—When drugs are powdered, loss is always experienced. This arises partly from the escape of fine particles, but principally from loss of moisture in drying. Again, in powdering almost all drugs, a portion remains which resists disintegration. This is called by the miller "gruffs," and is usually worthless and should be thrown away. The gruffs are frequently kept, however, and sent with the next lot of the same drug to be ground at the mill. The dose of a powdered drug is usually somewhat less than that of the same drug before it was pulverized, because the weight it has lost generally represents inert matter, water, etc. Powdered ipecac is a good illustration of this. The active principle *emetine* resides in the starchy cortical portion of the root; the internal ligneous cord constitutes the "gruffs" of ipecac, and is inert. The exception to this is the case of those drugs containing an active volatile constituent, like the aromatics, clove, cinnamon, nutmeg, or like asafetida, myrrh, cubeb, etc. These drugs, when powdered, generally contain less of their active constituents than they did before they were ground. The volatile oils to which their virtues are due are driven off to a greater or less extent by the amount of heat necessary to make them brittle enough to be readily pulverized. The U. S. Pharmacopœia recognizes the importance of this fact by directing myrrh "in moderately coarse powder," not fine powder, in tincture of myrrh and asafetida, not powdered asafetida, in emulsion of asafetida. If care is exercised in desiccating, the powders of most drugs possess all their medicinal properties, and in many cases they will retain indefinitely these properties unimpaired if they are properly preserved and not unduly exposed to air, light, or moisture.

FIG. 222



Desiccator

The practice of some drug millers of establishing a loss in the weight of a drug as a regular standard, and then making up the deficiency by adding the same amount of some inert substance, is reprehensible. That the amount of moisture present in different lots of the same drug varies greatly may be seen by a glance at the following table, compiled by Mr. T. J. Covell from accurate records obtained from Dr. E. R. Squibb's drug mills. The table is valuable because it represents the loss in powdering considerable quantities of drugs:

Table showing Loss in Powdering Medicinal Substances

Substance	Greatest Loss per cent. on any Single Lot	Smallest Loss per cent. on any Single Lot	Average Loss per cent.
Acacia	1.88	0.40	0.83
Acacia (granulated)	1.67	1.03	1.35
Aloe Capensis	19.31	7.09	11.13
Aloe Socotrina	24.62	10.00	17.31
Acidum Tartaricum	2.50	0.54	1.06
Buchu	4.10	0.20	2.00
Cambogia	2.46	0.74	1.35
Canella	3.07	0.50	1.77
Cantharis	6.22	0.63	2.05
Cardamomum	7.10	5.00	6.02
Cassia	2.90	2.26	2.61
Catechu	1.30	0.86	1.08
Cinchona Flava	3.75	1.18	2.57
Cinchona Pallida	2.22	0.96	1.73
Cinchona Rubra	1.72	1.24	1.58
Cubeba	3.55	1.99	2.40
Ergota	5.72	0.00	3.62
Extractum Glycyrrhizæ	13.06	8.14	10.45
Gentiana	11.79	9.20	10.23
Gentiana (ground)	8.30	1.56	5.09
Ipecacuanha	3.66	0.64	1.91
Iris Florentina	9.00	1.10	6.22
Jalapa	12.24	2.95	9.58
Myrrha	8.81	3.59	5.80
Opium	22.85	9.91	19.61
Podophyllum	1.15	0.49	0.75
Potassii Chloras	2.70	1.52	2.01
Potassii Bitartras	1.11	0.05	0.38
Pulvis Ipecacuanhæ et Opii	1.63	0.63	1.05
Rheum	3.40	0.10	1.74
Saccharum Lactis	0.85	0.70	0.78
Sapo	18.05	11.70	15.92
Sarsaparilla (Rio Negro)	0.96	0.35	0.70
Scammonium	5.65	1.33	2.70
Scilla	16.45	10.83	13.60
Valeriana	1.51	1.45	1.48
Tragacantha	7.38	6.47	6.93
Zingiber (nigrum)	3.72	3.13	3.43
Zingiber (album)	11.74	8.57	9.70

CHAPTER VIII

COMMINUTION

COMMINUTION is the process of reducing drugs to particles, or breaking up their state of aggregation.

Medicinal substances in their natural state require to be mechanically divided in order to facilitate the action of menstrua or solvents, or to permit their administration *per se* in the form of fine powders.

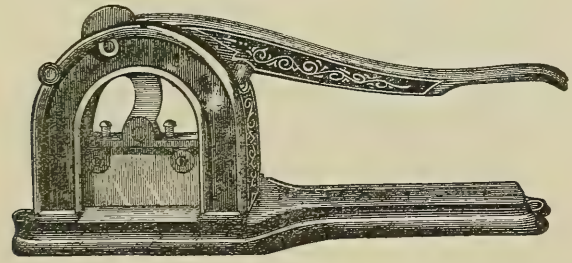
A simple illustration is offered in the case of alum. A solid lump of alum weighing one ounce, if added to a pint of water, will not dissolve nearly so quickly as will one ounce of the same alum in the same quantity of water *if finely powdered.* Vegetable substances offer very variable degrees of resistance in powdering, owing to the proportion and toughness of their ligneous fibre and the amount of cellular tissue.

Under the head of comminution will be grouped the various mechanical operations used in pharmacy by which the surface of solid substances is increased, whether by cutting, rasping, grating, chopping, crushing, rolling, stamping, grinding, powdering, triturating, levigating, elutriating, granulating, or similar processes.

By far the greater number of substances employed in medicine belong to the vegetable kingdom, and, while many of the processes of comminution used for these are also applicable to the chemical substances of the materia medica, it will be necessary in the following chapter to note the apparatus specially adapted to each class.

Cutting, Slicing, and Chopping.—This process is used principally in bringing roots, barks, leaves, herbs, etc., to the proper condition for treating with suitable solvents. For very small operations either the pruning knife or pruning shears answers a good purpose. The tobacco knife or herb cutter shown in Fig. 223 is well

FIG. 223

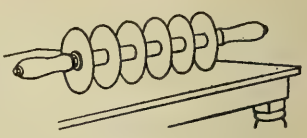


Tobacco cutter

adapted for the purpose. It should be observed, however, that the principle upon which a knife operates successfully should be carefully carried out in constructing apparatus designed for cutting. Direct

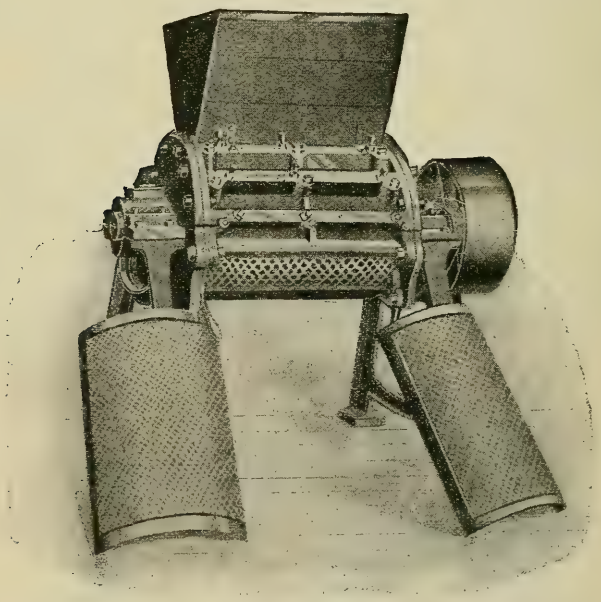
pressure without a slight drawing or sawing motion is not effective; therefore those knives which have guides arranged so that the knife edge sunders the particles at an angle are greatly preferred. Fig. 224 shows a roller knife which is very serviceable. It is made by W. Weber, Evansville, Indiana. The circular blades or knives are made of the same quality of steel that is used for saws, and are mounted upon a shaft, being separated by a series of spools or collars. The handles are of wood and mounted on the ends of the shaft, so that they are loose upon the shaft, thus permitting the handles to be grasped tightly while the roller knife revolves. The substances to be cut are placed upon a smooth board and the roller knife passed over them with more or less pressure. Upon the large scale drugs are cut with hay cutters, implements usually consisting of four or more circular blades fastened to a shaft and revolving at the end of a trough, down which the substance that is to be cut is gradually fed. Sarsaparilla root is cut in this way before it is contused. Fig. 225

Fig. 224



Roller knife

Fig. 225



Rotary cutter

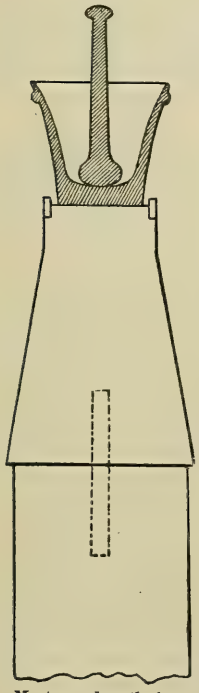
shows a rotary cutter made by the Abbé Engineering Company, of New York. A cylinder to which is attached five knives revolves in a circular case, upon the inside surface of which are fastened six knives; the knives are straight but are set at a slight angle, so that a "shearing action" is exerted on the substance to be cut. The bottom

of the case consists of a perforated plate, which can be replaced, and as the knives revolve a portion of the cut substance drops through the perforations. What remains is carried around and again subjected to the action of the cutters; by selecting the perforated plates the product may be cut coarser or finer as required.

Rasping or Grating.—A half round rasp (see Fig. 166) or a nutmeg grater is very useful at the prescription counter, as it frequently enables the pharmacist to prepare a small quantity of a powder for a prescription in case the regular stock bottle is found empty or a very fresh powder is needed. The small pocket pepper mills used by European travellers, but now to be obtained in this country, for grinding whole pepper at the table will be found especially useful.

Contusion, or bruising, is an operation very frequently resorted to. It may be defined as the process of reducing a drug to particles by striking it a succession of blows. The instrument generally employed is the well known mortar and pestle, which, for contusing drugs, should be made of cast iron, bell metal, or brass. The shape best adapted for this purpose is shown in Fig. 226, the mortar being represented on a mortar block. The bottom of the mortar should be flat and heavy, so that it may rest firmly upon whatever base it is placed; the sides should flare slightly, but the mortar should be so deep that substances will not be easily forced out on to the floor by the blows of the pestle. A leather or wooden cover should be used upon the mortar when corrosive or irritating substances are contused. The pestle should be heavy and sufficiently flat on the under surface to permit the convexity nearly to coincide with the concave surface of the mortar. The inner surface of the mortar should be tinned, to prevent rusting and facilitate cleaning. The best support for an iron mortar is the top surface of a hard wood post six or eight inches in diameter and of sufficient length to pass from the top of the floor into the cellar and rest on the ground. A turned wood mortar block two feet high should rest upon the post; this block should have a flat iron hoop upon the top projecting half an inch above the surface, as suggested by Dr. H. T. Cummings, while the bottom should have an inch hole bored up through the centre for the distance of twelve inches; an inch wooden pin, two feet long, should be firmly fixed in the centre of the post for the distance of twelve inches, which would leave twelve inches of the wooden pin projecting above the floor. Now, if the mortar block is placed over it so that the pin enters the hole in the base, it will be found that a solid foundation is provided for resisting the blows of the pestle, and jarring and vibration, so destructive to balances and fragile apparatus, are prevented.

FIG. 226



Mortar and pestle (on a mortar block)

When for good reasons the post support cannot be used, the next best base is a deep, strong box filled with dry sand. The principal

objection to this is the constant loss of the sand and the inconvenience of having it spilled on the floor. When it is necessary to use an iron mortar and pestle for a continuous operation, for a considerable length of time, it will be found advantageous to connect the upper part of the pestle with an elastic wooden spring attached to the ceiling, so that the labor of lifting the pestle will be lessened. This spring is preferably made from a tapering hickory strip seven or eight feet long and four inches wide at the base, the rope connecting the pestle with the end of the spring being of such length that the pestle barely touches the bottom of the mortar when the spring is stretched to its utmost tension. On account of the large number of mills scattered over the country, established for grinding drugs, and the increase of facilities for grinding and powdering drugs on the large scale, the skilful use of the mortar and pestle by the pharmacist must be regarded as a lost art. The necessity for thoroughly drying drugs before subjecting them to comminution has already been mentioned. (See Desiccation.)

Wooden mortars and pestles are occasionally used for contusing soft bodies, like prune pulp, almonds, recent fleshy roots, substances that are affected by iron, etc. Lignum vitæ is a very hard and suitable wood for this purpose, although boxwood is preferable when it can be procured, because it has less tendency to split.

Marble mortars are also used for operations of a similar character on a somewhat larger scale; but care must be used to avoid putting substances containing acid into such mortars, on account of the reaction upon the marble and the consequent contamination of the product.

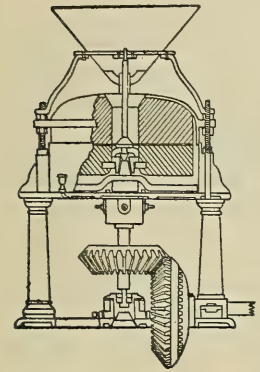
Grinding and Pulverizing.—The former term is applied to the reduction of a substance by mechanical means to *coarse* particles, the latter to the production of *fine* particles. These processes are the most important of any grouped under comminution. At present they are very largely carried on by drug millers. It is necessary for the pharmacist to be familiar with the methods employed, however, if intelligent judgment is to be exercised in the subsequent treatment of the vegetable and mineral substances of the materia medica. Before pulverizing a substance it must be dried, and the desired fineness of the powder determines the character of the preliminary treatment. In order properly to grind or powder substances upon the large scale, special knowledge and experience are required; previous acquaintance with the methods best suited to accomplish the object on the small scale, while useful to some extent, will be found inadequate. If a drug is to be coarsely ground, the necessity for thoroughly drying it is generally not so pressing as when a fine powder is to be made of the substance; drugs containing volatile oils are apt to be rendered worthless if they are dried sufficiently to enable them to be ground to a fine powder. Myrrh, cloves, cubebs, nutmegs, etc., afford good illustrations of this; hence these drugs are preferred when coarsely powdered. Within the last few years an important change in pharmaceutical practice in this respect has been effected, and preparations in which formerly very fine powders were directed are now ordered to be made from coarse powders; the processes for extracting the soluble principles having been greatly improved, the

necessity no longer exists for using the very fine powders, and hence volatile principles are not sacrificed.

Drug Mills

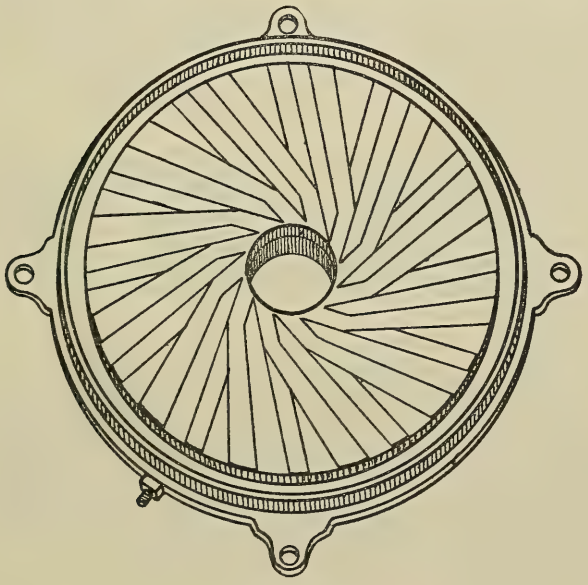
The buhrstone mill is very extensively employed in drug milling. There are two kinds, termed respectively under runners and upper runners. The principle upon which this mill operates is that of reducing the substance to particles by the friction and contusion that follow the delivery of the substance in the contracted space formed by a rapidly revolving stone disk, brought in nearly close contact with a similar disk which is stationary. In the under runners the upper stone is stationary and the lower stone revolves, the upper stone having a central circular opening through which the substance is fed, as shown in Fig. 227, the under stone being connected with the shaft. In the upper runners the lower stone is stationary, the upper stone being perforated as in the under runners. In both, the stones revolve horizontally. The stone used must be very hard. The best buhrmill stone is obtained from the old and celebrated quarries of La Ferté-sous-Jouarre, in France. The surfaces of the millstones are crossed

Fig. 227



Buhrstone mill

Fig. 228



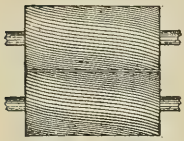
Buhrstone

with "furrows," which pass from the centre to the circumference, as shown in Fig. 228. The object of the furrows is to provide a means

for the passage of the ground particles to the outer circumference and to the trough. This is accomplished through the centrifugal force and current of air caused by the rapid revolution of the stone in motion. The fineness of the powder is regulated by raising or lowering one of the stones, this of course increasing or decreasing the space between them ; the character of the powder is also influenced by the dressing of the stone. Fig. 227 illustrates one of the best of the buhrstone mills,—Munson's under runner.

Roller mills operate by crushing, or crushing and cutting, the substance. In their simplest form they consist of two smooth faced iron rollers revolving in opposite directions, which can be brought into close contact by regulating screws. The principle has been extended and improved in modern milling, so that for grinding certain drugs this mill gives excellent results. The rollers are now made of steel, chilled iron, or biscuit (porcelain), and are corrugated or ribbed to suit special purposes. The sections of these corrugations are serrated, undulated, or crenated. The rollers revolve in the same direction or in opposite directions, and at equal or different speeds. Fig. 229 shows the position of the grooved rollers, and Fig. 230 shows a sectional view of the same. Corrugated roller mills are used in grinding drugs, but they are much more largely employed in flour mills.

FIG. 229

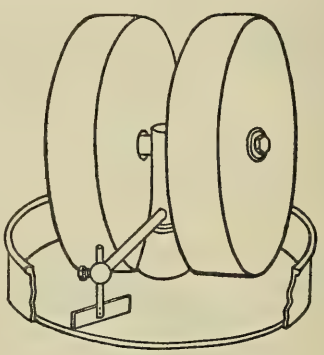


Grooved rollers

FIG. 230

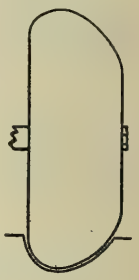
Grooved rollers (cross section)

FIG. 231



Chasers

FIG. 232

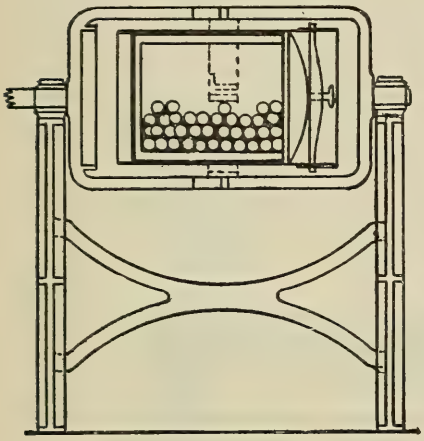


Chasers (curved grinding surface)

Chaser mills are so called because two heavy granite stones, mounted like wheels and connected by a short horizontal shaft, are made to revolve or *chase* each other upon a granite base (see Fig. 231). The stones are discoid, and the grinding surfaces are the circumferential edges of the stones and the surface of the granite base ; an iron cylinder, called a "curb," surrounds the circular base, and a "scraper," made of iron and adjusted at an angle, is connected with the shaft. It is evident that if the substance to be powdered is delivered upon the granite base in the path of the rapidly revolving stones it must speedily be reduced to powder, not only on account of the crushing weight of the heavy stones, but also because of the attrition caused by the outer edge of the stone travelling through a longer distance than the inner edge. In some mills the stones having flat, grinding surfaces have been replaced by stones having curved surfaces, and the flat base by a circular gutter curved to correspond with that of the surface of the stone. In this way the grinding surfaces

have been greatly increased and rapid pulverization facilitated. Fig. 232 shows the shape of the stones of this form in use in Squibb's drug mill. In practice the chasers are enclosed in a tight box or small room, closed with air tight doors, and the substance to be powdered is fed in from the top by an elongated funnel, the spout of which delivers the material immediately upon the path of the stones. The height of the curb is increased by pasting heavy paper around it, and the fineness of the powder is influenced by the height of the curb. The revolution of the chasers produces an upward current of air; this carries over the lighter particles, which fall outside the curb and are subsequently collected as a fine powder; those particles which are larger are of course heavier and cannot rise to the height of the curb, but fall back under the stones to be reground. In this way refractory substances can be reduced to very fine powder. Chasers are more largely employed in making "dusted" or very fine powders than any other form of pulverizing apparatus.

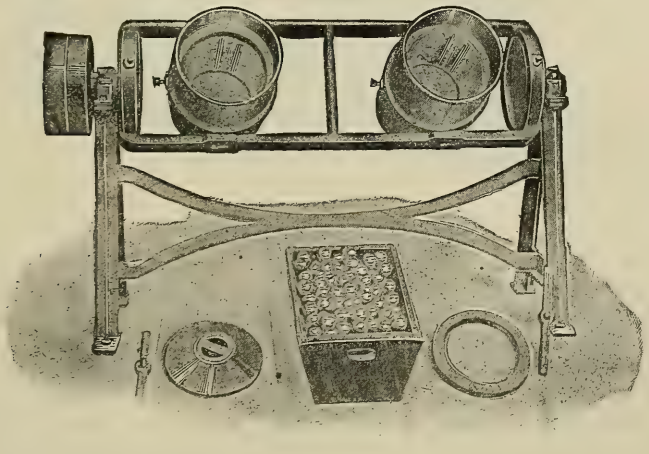
Fig. 233



Single jar mill

Pebble Mills.—These mills are operated on the principle of *attrition*, the grinding being effected by bringing the substance in contact with "pebbles" of flint or porcelain balls confined in jars or cylindrical

Fig. 234



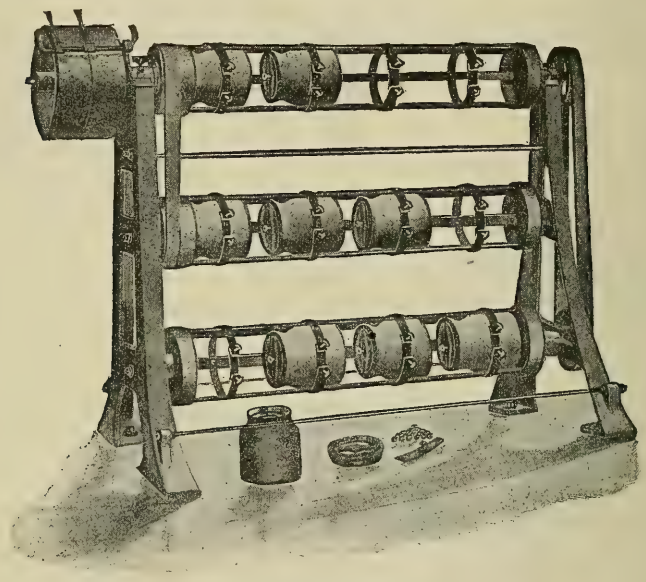
Double jar mill

vessels which are caused to revolve at a regulated speed. The advantages of such mills is that they afford a large grinding surface within

a limited space. They are cleanly in their action, economical, and, on account of the simplicity of their construction, not liable to get out of order. Much depends, however, upon the hardness of the pebbles; for it must be seen that these are continually operating against each other while in action, particularly if care is not used in "feeding" the mill frequently. Such mills are adapted for grinding friable substances, extracts, chemicals, etc. Fig. 233 shows a sectional view of a single jar mill, Fig. 234 illustrates the double jar mill, while in Fig. 235 three batteries of laboratory mills are shown. The advantage of this combination is that four, six, or a dozen different substances may be ground at one time, and, as it is not necessary to put a definite weight in each jar, the quantity can be made to suit the demand.

Mills with Iron Grinding Surfaces.—Many mills have been constructed from time to time to suit special purposes. These cannot

FIG. 235

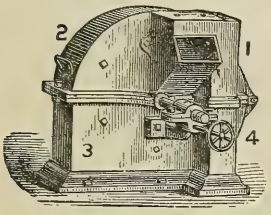


Battery of pebble mills

be noticed at length in a work having the scope of the present one. *Barrel mills* have been used. These consist of strong barrels lined with sheet iron, supported by strong iron shafts attached to the heads. The substance to be comminuted is placed in the barrel, and large round iron balls, like cannon balls, are introduced. Upon revolving the barrel rapidly, disintegration is effected. This principle is used also in pulverizing dried extracts and friable substances. A hollow circular iron ring, having a diameter slightly larger than that of the cannon ball which is placed inside with the charge of substance to be powdered, is made to revolve rapidly; the inertia of the cannon ball and the friction render its speed less than that of the ring, and the

substance is quickly ground. The *Bogardus mill* is constructed on a very ingenious principle. The grinding surfaces are two horizontal chilled iron plates, the lower one revolving, the upper one stationary ; both have corrugations having sharp edges, arranged concentrically. The peculiarity of this mill is that the centres of the grinding plates are not directly over each other as in buhrstone mills, but the centre of the lower plate is placed a few inches to one side ; by this arrangement the substance to be ground is caught by the ring edges of the revolving plate and dashed against the cutting edges of the stationary upper plate at an angle, the effect being to incise it as if cut with scissors and crush it at the same time.

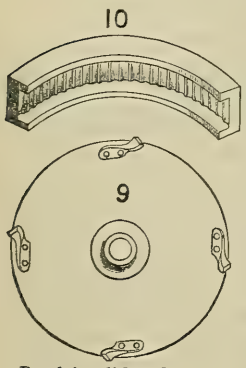
Fig. 236



Mead's disintegrator

Mead's disintegrator differs from the mills thus far considered in the principle of construction, in the character of the grinding surfaces, and in its method of operation. The grinding is effected by hardened steel beaters riveted to a steel disk, which revolves vertically between corrugated rings ; the beaters are placed on the side of the disk nearest to the feeding trough, and catch the material as it enters the mill, beating it with great force against the corrugated rings until it is fine enough to pass between the disk and the face of the rings ; as soon as it passes here, it is on the side of the mill from whence it is discharged, and all that is fine enough is immediately driven out by the beaters on the back of the disk. That portion of the substance which is not fine enough is caught by the beaters and beaten against the screens until sufficiently fine to pass through.

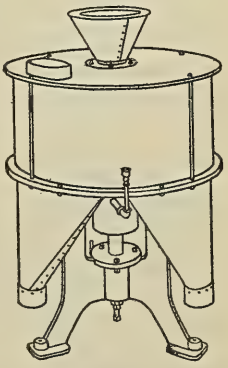
Fig. 237



Revolving disk and screens

The screens are two inches in width, and extend around three-fourths of the diameter of the mill. They are made of square steel bars, and present a grinding surface to the beaters, but there is sufficient space between them to permit the passage of fine particles. The substance, as it is ground, falls into a receiving box below the mill, or is discharged through the floor into a room below. One prime requisite in running this mill is high speed. The disk must make three thousand revolutions a minute. The disintegrator is capable of grinding one hundred and fifty pounds of Ignatia bean, or six hundred pounds of wild cherry bark, in one hour. Fig. 236 gives an illustration of the mill, while Fig. 237 shows an enlarged view of the revolving disk and a section of the screens immediately above.

Fig. 238



Max mill

The Max mill (Fig. 238) made by the Abbé Engineering Company,

like Mead's disintegrator, acts on the principle of *percussion*. Power is conveyed by a vertical shaft, to which is attached a carrier provided with hard steel beaters, and as the substance is fed into the mill it is thrown by centrifugal force against a corrugated hard iron plate, the particles at the same time being thrown into violent contact with each other. Coarse or fine powders can be made at will.

Hand Mills

It is more difficult to construct a drug mill for the general use of the pharmacist than one for the special purposes of a drug miller. The latter has the choice of a buhrstone mill, chaser, disintegrator, iron mill, etc., which he can adjust to suit the character of the substance he desires to grind. The pharmacist's drug mill, on the other hand, is expected to do all kinds of work rapidly and well. It must, therefore, be capable of ready adjustment, possess durability, and have cutting surfaces not quickly dulled, and working parts not liable to get out of order.

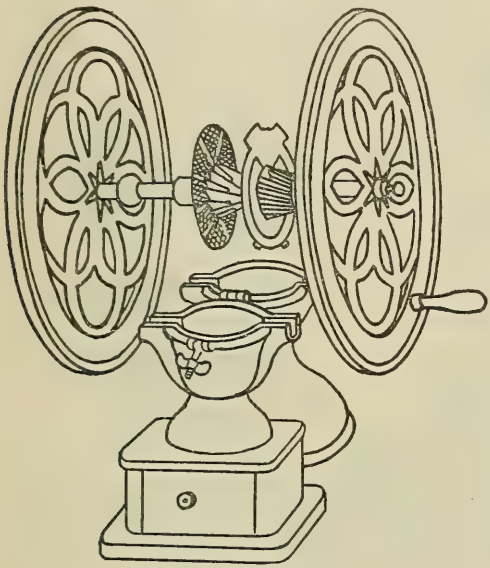
It is not easy to realize that every medicinal substance has an individuality of its own, but he who neglects the study of the physical characters of the substances of the materia medica can never expect to overcome successfully the obstacles which stand in the way of disintegration. Hand drug mills may be divided into three classes: 1. Those having vertical grinding surfaces. 2. Those having horizontal grinding surfaces. 3. Those having conical grinding surfaces. They have the following points in common: iron is the principal material of construction, the grinding surfaces are of hardened iron or steel and consist of teeth arranged in concentric rows, and the regulation of the fineness of the powder is effected by a screw or screws, by which the plates are made to approach or recede from each other.

1. Hand Drug Mills with Vertical Grinding Surfaces

Swift's Mill (old style).—This hand mill has been in use longer than any other in the American market. Its introduction marked an era in the history of pharmacy, and, although superseded now by greatly improved mills, it is still remembered with grateful feelings by those of the present generation, who had been previously accustomed to laborious mortar practice. In this mill there are two vertical grinding plates, one of which is stationary, while the other is connected with the horizontal revolving shaft; a conical breaker is also attached to the shaft, and when in position it is immediately below the lower opening of the hopper; a fly wheel with a handle is bolted to the outer end of the horizontal shaft, and furnishes the power required. The teeth are of iron and arranged in concentric rows, and the plates are made to approach each other or to separate by an adjusting screw. The supports of the mill are of ash or oak, and are durable and firm. The principal disadvantages of this mill are the difficulty of cleaning it, its slow action, its liability to become clogged, and the absence of a tight box or drawer to receive the ground drug. Two improvements have been made in the Swift's new style mills. In one the fly wheel has been made larger and heavier, in the other a double fly wheel has been attached.

Troemner's Mill, while constructed upon the same principle as Swift's, is much more thorough in its action, and requires less labor to operate it, than Swift's mill (old style). It has vertical plates, a thumb screw to regulate the fineness of the powder, a heavy fly wheel, and a close fitting drawer to receive the powdered drug. It is not so easily cleaned, however, as the next mill to be mentioned.

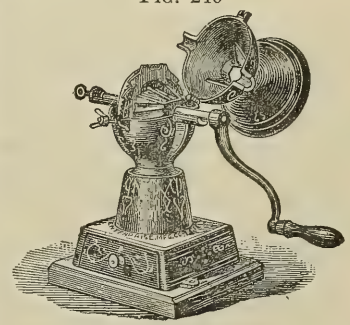
Fig. 239



Enterprise drug mill

The Enterprise Mill.— The introduction of this mill, in 1875, gave an impetus to the manufacture of hand drug mills which is still felt. The application of several new principles, and the extension and improvement of some valuable old ones, at once gained the attention of practical pharmacists. The great advantage possessed by this mill over those in the market at the time it was introduced was the ease with which the interior and the working parts could be reached. The principle of supporting the grinding plates upon a horizontal shaft, to the extremities of which heavy fly wheels were attached, and providing a means for lifting all the working parts out of the interior to facilitate their cleaning, were novel features. Fig. 239 so thoroughly illustrates this mill that it is hardly necessary to dwell upon its other features. The left hand grinding plate revolves, being geared to the shaft, while the one on the right hand is stationary. When in position for grinding they are, of course, nearly in contact. The opening of the interior is effected by simply turning the thumb screw in front. A smaller mill is shown in Fig. 240. It is very conveniently used at the dispensing counter.

Fig. 240



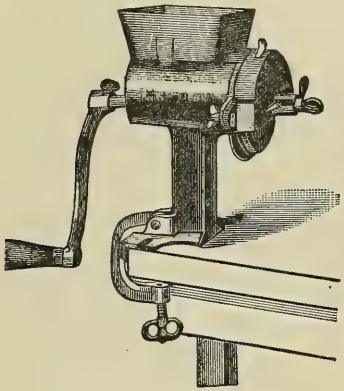
Drug mill (dispensing)

The small mill, made by the A. W. Straub Co., of Philadelphia, shown in Fig. 241, is very useful at the counter of the pharmacist for grinding small quantities of drugs; the plates and crushers are also shown. Ball bearings are used to facilitate easy running. The adjustment for making coarse or fine powders can be quickly changed, and it is the best small mill in use.

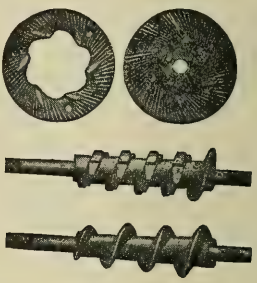
2. Hand Drug Mills having Horizontal Grinding Surfaces

Thomas' s Mill.—This was one of the first hand drug mills made upon this principle. There are two horizontal grinding plates, the lower one revolving and the upper one stationary. A vertical shaft, which is geared to a horizontal shaft by bevel wheels, communicates the power to the lower plate upon revolving the fly wheel. The absence

FIG. 241



Quaker City F. No. 4 mill



Plates and crushers

of a closed receptacle, and the difficulty of quickly cleaning the grinding surfaces, are the principal objections to this mill.

Swift's B Mill.—This is a comparatively new mill, very different in appearance from the old Swift's mill, and different in principle. The grinding plates are horizontal, the lower one revolving, while the upper one is stationary and forms the lower part of the hopper. It has two fly wheels, but the receptacle for the powder is an open one. A valuable feature of the Enterprise mill is present here,—*i.e.*, that of opening horizontally in the centre. The fineness of the powder is regulated by raising or lowering the lower plate by the thumb screw.

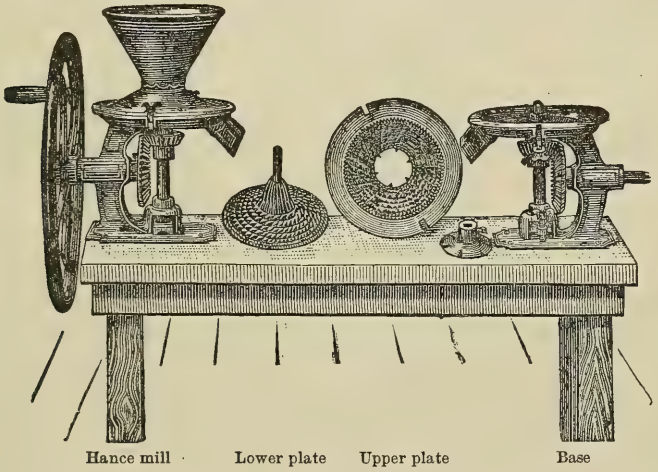
3. Hand Drug Mills having Conical Grinding Surfaces

The principle of construction in these mills is probably the best, because it avoids the fault of those constructed on the vertical plate principle, that of permitting particles to drop into the receptacle before they are finely ground, and also the fault of the horizontal plate mills, which may hold the ground particles too long, often until clogging results. The conical plate mill, if properly constructed, leaves little to be desired.

Hance's Mill is made on this principle. Formerly, the objection to this mill was the loss of time and labor consumed in getting it apart. This has been obviated by the introduction of the principle of opening it horizontally with the same kind of thumb screw and hinge that is used in the Enterprise mill. The Hance mill is better adapted for heavy work than any other of the hand drug mills, and, if desired, a belt and pulley can be attached for steam power. The lower plate is conical in shape, the summit being elongated into a breaker; the

teeth are arranged in consecutive rows, a scraper being attached to the under surface of the lower plate ; the upper grinding surface is situated upon the lower surface of the hopper, and corresponds in shape and in the arrangement, number, and size of teeth with the surface of the lower plate. The revolving plate is attached to the upright shaft by a simple key ; this permits the easy removal of the plate when the mill is to be cleaned, yet holds it securely when in operation. Power is communicated by means of two shafts at right angles, geared with bevel cog wheels. The fineness of the powder is regulated by a thumb screw at the base, which elevates the revolving plate. The support to the mill is a strong iron frame, which is cast in one piece, and, although the mill has but a single fly wheel, this is partially compensated for by the length of the bearing for the horizontal shaft. Figs. 242 and 243 show the form which is designed to be bolted to the working table or counter ; the new form, in which the mill is mounted on a box stand, may be preferred by

Fig. 242 Fig. 242*a* Fig. 242*b* Fig. 243



some. Fig. 242*b* shows the upper grinding plate, and Fig. 242*a* the lower plate ; a feeder is shown lying upon the counter, which is fastened to the upper portion of the lower plate by its set screw, so that seeds and similar drugs may be automatically fed to the mill.

General Rules for operating Hand Mills.—Much of the dissatisfaction experienced in operating hand mills has arisen from improper methods of using them, or from failure to measure accurately the degree of resistance to disintegration possessed by the substance to be ground. One of the first requisites, as before mentioned, is to dry the substance as perfectly as its physical character will permit without injuring it. If coarse, bulky, fibrous roots, barks, or similar substances are to be ground, they must first be cut or bruised. Most substances are ground with less labor if they are first passed through the mill with the coarse adjustment, returning the portion which is sifted out, for regrinding, after setting the plates more closely together. This plan is repeated until the whole is ground. Care should be taken

not to feed the substance into the hopper faster than it can be ground. The desire to get through quickly is the most frequent cause of clogging the mill, and when this occurs much time is lost, and the operator is strongly reminded of the well worn proverb about undue haste. If a considerable quantity is to be ground, two persons can operate the mill more economically than one,—one feeding the mill carefully, the other supplying the physical labor, and, after the expiration of a given time, exchanging places. Good judgment is necessary in determining the rapidity with which substances can be fed into the hopper. Resinous or oily drugs, or substances which soften by heat, require very careful treatment and cannot be fed rapidly; dry ligneous barks or roots, on the other hand, can be fed as rapidly as the extent of grinding surface of the mill and the muscle of the operator will permit. The mill should be thoroughly cleaned after each operation, particular attention being given to the grinding plates. In the case of substances which form hard lumps by heating or clogging up the plates, the quickest way is to use boiling water to soften or dissolve the lumps; the plates should then be quickly dried, to prevent rusting. By running sawdust or rice chaff through a mill, after an odorous drug has been ground, it may be speedily cleaned and freed from odor.

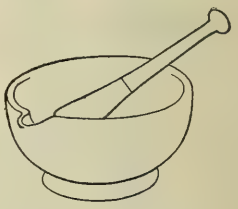
Fig. 244

Trituration

Fig. 245

Spiral track of the pestle

Fig. 246



Mortar for trituration

Trituration is the process of reducing substances to fine particles by rubbing them in a mortar with a pestle. The pestle is given a circular motion, accompanied by downward pressure, and the most effective method of using the pestle is to begin in the centre of the mortar and describe a circle of small diameter with the pestle on the substance, and gradually increase the size of the circle with each revolution until the side of the mortar is touched, when the motion is reversed and circles continually smaller in diameter are described until the centre is reached. This is repeated until pulverization is effected. By this treatment all the particles are brought under the action of the pestle. Fig. 244 shows the manner of holding the mortar during trituration and Fig. 245, the spiral, showing the direction traversed by the pestle in trituration as described above. The mortar and pestle best adapted for this operation have the shape shown in Fig. 246. Mortars with pestles having flattened ends are the best. Wedgwood ware is very serviceable, but is difficult to keep clean. As triturating mortars are rarely subjected to blows, porcelain mortars of proper shape are preferred. One of the principal annoyances in the use of wedgwood or porcelain mortars and pestles is that of the continual loosening of the handle of the pestle. The cement employed by the manufacturer is chiefly rosin of bad quality, and in using the pestle the particles of loosened cement often

drop into the mixture in the mortar during trituration. The best plan is to pull the handle out of the pestle entirely as soon as possible and reset it. This is easily done by heating the end of the pestle in a sand bath until the cement has softened so that the handle may be extracted, then some hot cement (good sealing wax) is poured into the pestle hole, and the wooden handle is at once pressed forcibly in and held in its place by wedging or other means until the sealing wax has hardened. The hard rubber handle, which is made to screw accurately into the pestle (see Fig. 247), is a great improvement over the ordinary handle, and the additional cost is more than repaid by the comfort of using it. Where trituration is combined with contusion, as frequently happens in effecting solutions of chemical substances, a wedgwood mortar of the shape shown in Fig. 248 is well suited for the purpose. The selection of good mortars and pestles is frequently overlooked amidst the many items of detail in furnishing a pharmacy; but few implements bring more satisfaction to the operator than good mortars and pestles. It is a safe rule to examine every purchase carefully before accepting it finally, to see whether the pestle fits the mortar accurately. It should have as much bearing on the interior surface of the mortar as its size will permit, because the rapidity of the trituration depends largely on the amount of contact of the surfaces. The use of a round surfaced pestle in a flat surfaced mortar is just as great a waste of labor as that of a flat surfaced pestle in a round surfaced mortar. Trituration, as a distinct method of preparing a class of preparations, was officially recognized in the U. S. Pharmacopœia of 1880, and a new preparation, *Trituratio Elaterini*, made by triturating elaterin with sugar of milk, was introduced.

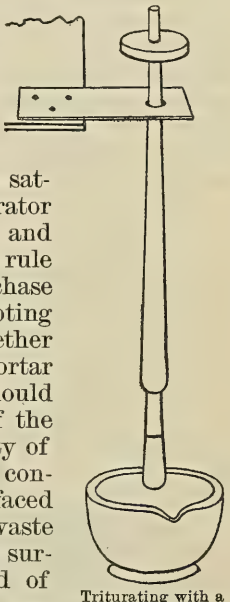
Fig. 247

Pestle, hard rubber handle

Fig. 248

Wedgwood mortar and pestle

Fig. 249



Triturating with a loaded pestle

Fig. 249 shows a device for facilitating trituration. It was communicated by Charles Rice, and is simpler and more effective than similar contrivances which have been described. It consists of an ordinary mortar and pestle, the latter having been lengthened by cutting down the mushroom top of the handle, so as to admit of its being inserted into the large end of a wooden handle, shaped somewhat like a ball bat, and between two and three feet long. The upper end of this handle should be about an inch in diameter, and during the use of the pestle is to be kept upright and steady by passing through an opening in a piece of heavy pasteboard or wood which may be tacked to the under side of some convenient shelf. The mortar should stand on a counter about three feet from the floor, and the

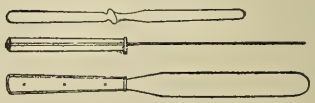
upper end of the pestle pass through a shelf above. To stop the noise caused by the pestle striking against the sides of the opening, a piece of sole leather is attached to the under side of the shelf and the pestle passed through a hole in its centre. This also serves another purpose,—viz., when it is necessary to raise the pestle to admit of changing or stirring the contents of the mortar, the leather will clasp the enlargement of the handle so as to suspend the pestle securely out of the way of the hands. In using the apparatus, one hand grasps the handle just above its lower end, and a very slight effort is requisite to give it the necessary motion. The weight of the handle is usually sufficient to insure a proper degree of friction. If, however, more pressure is desired, the pestle can be weighted by slipping a perforated weight on to an iron pin driven in the top of the handle.

Mortars and pestles are sometimes made of green or white glass. The former are to be preferred because they are stronger; the latter, however, present a handsomer appearance. Glass mortars are not adapted to the continued trituration of hard substances. They are useful only in dissolving certain chemical substances directed in prescriptions, like corrosive sublimate, the alkaloids, etc. It is best to place the glass mortar over a dark surface, in order to show by contrast more clearly when the solution of the white object is effected.

FIG. 250

Porcelain mortar and pestle

FIGS. 251, 252, 253



Solid handle and balanced handle spatulas

Porcelain mortars and pestles (see Fig. 250) are, however, more generally useful as solution mortars. Pestles entirely of porcelain are objectionable, because they are easily broken.

Spatulas.—The process of trituration as ordinarily performed requires the use of spatulas. These consist of flexible steel blades attached to handles, and in trituration they serve to loosen the substance as it becomes packed upon the sides of the mortar. Spatulas are largely used in extemporaneous pharmacy, and they will be alluded to frequently under various special heads in Part V. The blade of a spatula is frequently broken when too much pressure is applied, but if the broken blade remaining in the handle have its sharp corners ground off upon a grindstone, or filed off, it will be just as useful for some purposes as it was when perfect.

Spatulas may now be had of excellent quality, and greatly improved in style over those formerly used. The best form is the balanced handle spatula (see Fig. 252). In this the metal of the handle and that of the blade are continuous and of the same width, so that the annoyance of the tang becoming loose in the handle, as in the old style spatulas, is avoided. The flat metal handle is enlarged by riveting smooth, flat pieces of hard wood to it to insure convenience in using. The balanced handle derives its name from the fact that when lying upon the counter the weight of the handle is sufficient to over-

come the weight of the blade, so that contact of the blade with the counter is prevented. Solid handled spatulas (see Fig. 251) are also made, the whole being of one solid piece of metal, and the handle being nickel plated. A pocket spatula, which closes like a clasp knife, is also furnished by dealers.

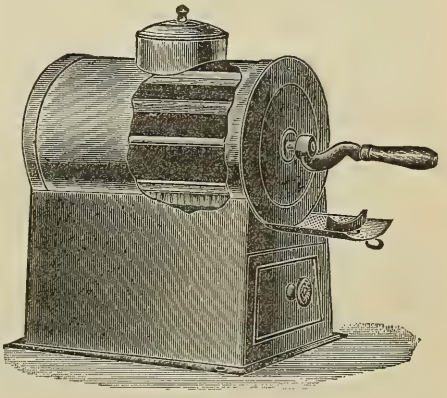
Fig. 254

Spatula, blade coated with hard rubber

Fig. 254 shows a spatula coated with hard rubber for making ointments which contain corrosive substances, or substances acting on steel. Solid hard rubber spatulas are also made.

Sifting is the process of passing a powdered substance through the meshes of perforated material with the object of separating the coarser from the finer particles. Sieves are employed in this process. The frames are usually round, although sometimes they are oval, square, or rectangular. The ordinary sieve is usually made by stretching wire gauze over a flat wooden ring, and keeping it in its place by slipping over it a narrow wooden ring of slightly greater diameter, which is tacked securely. Covered sieves, or drum sieves, have tight covers for the top and bottom. The simplest pharmaceutical sieves for general use are obtained by making five rectangular frames, each four inches deep, ten inches wide, and sixteen inches long. These should be light but strong, and the bottoms covered with brass wire gauze of different degrees of fineness. A box, ten inches deep, twelve inches wide, and twenty-two inches long, with a tight cover, is provided to hold the sieves and prevent dust from escaping. Two cleats are nailed horizontally upon the sides of the box, five inches from the top, for the sieve to slide upon, and a hole is cut in the front of the box in order to permit a handle, with a hook at the end, to pass through and be attached to a screw eye in the front side of the sieve; two large corks are screwed to the back of the sieve at either end to act as buffers. The powdered substance is introduced into the proper sieve, which is placed upon the cleats, and the handle passed through the hole and hooked to the sieve; the cover is then placed in position, and the sieve pushed backward and forward, touching the back lightly.

Fig. 255

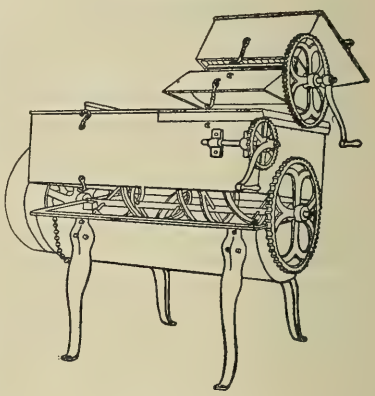


Jones's mixer and sifter

A very important point, which must not be omitted after sifting substances, is the thorough mixing of all portions of the sifted powder, in order that each part of the finished powder may have a uniform composition. The starchy portions of a drug will be powdered more quickly than the ligneous portions, and will usually pass through the sieve first; hence the sifted powder must always be thoroughly mixed. Upon the small scale this may be easily effected with a

spatula or mortar and pestle; upon a larger scale special apparatus is needed. Fig. 255 shows the Jones's mixer and sifter, which is well adapted for smaller operations; the principle is that of using revolving mixers and brushes. A perforated metal plate forms the bottom of the sifter, and, when mixing, an unperforated plate is pushed over the perforated plate, so that when the powder is thoroughly mixed this plate can be pulled out, and the powder then sifts through the perforated plate into the drawer below. Hunter's sifter is one of the most effective large machines; it is shown in Fig. 256. In this the powder is sifted in the cylindrical sieve, and adhering particles or small lumps are brushed through by the revolving brushes; the revolving spiral mixers in the large box cause the particles to be thoroughly mingled. The illustration shows the method of operating so well that further description is unnecessary.

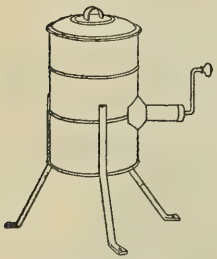
Fig. 256



Hunter's sifter

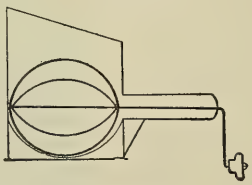
In Fig. 257 is seen an enclosed sifter well adapted for many purposes, while Fig. 258 shows a sectional view of the same kind of sifter for smaller operations. The sieve is hemispherical in shape, and is contained in a tinned iron scoop (see Fig. 259, which shows the end view). Two circles of stout wire are soldered to a central axis at right angles to each other, and the axis passes through the tin handle and terminates in a crank. When a powder is placed in the scoop, and the wire rings are made to revolve by turning the axis with the hand, the particles of powder are rapidly forced through the meshes of the sieve. This apparatus is especially useful in breaking up moistened lumps in powders which are about to be percolated. (See Percolation.)

Fig. 257



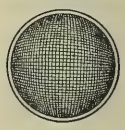
Enclosed sifter

Fig. 258



Scoop sifter

Fig. 259



Scoop sifter sieve (end view)

U. S. P. Description and Standards.

Fineness of Powder.—The fineness of powder is expressed, in the Pharmacopœia, either by descriptive words (generally so in the case of brittle or easily pulverizable substances), or in terms which formerly indicated the number of meshes to a linear inch of the sieve through which the powder will pass. The corresponding values, in metric terms, are now used in the U. S. P. IX Standards to indicate the maximum diameter of the particles which will pass through a sieve of the number named.

This was considered to be a more definite standard because the diameter of the wire (gauge number) used in making sieve cloth has an important influence upon the size of the mesh, and the thickness of the wire cannot always be uniform in sieves of different size and when made for various purposes. The U. S. P. standard is as follows:

"A powder of a specified number must meet the requirements given below for that number of powder, but the larger proportion of it must not pass through a sieve of a lower degree of fineness.

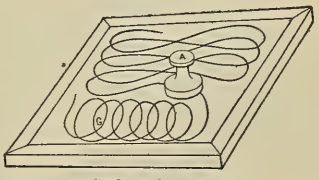
Number of Powder		Diameter of Particles
No. 100	Powder has a fineness, in diameter of particles, less than	0.14 millimeter.
No. 80 Very fine powder	Powder has a fineness, in diameter of particles, less than	0.17 millimeter.
No. 60 Fine powder	Powder has a fineness, in diameter of particles, less than	0.23 millimeter.
No. 50 Moderately fine powder	Powder has a fineness, in diameter of particles, less than	0.28 millimeter.
No. 40 Moderately coarse powder	Powder has a fineness, in diameter of particles, less than	0.38 millimeter.
No. 30	Powder has a fineness, in diameter of particles, less than	0.54 millimeter.
No. 20 Coarse powder	Powder has a fineness, in diameter of particles, less than	0.85 millimeter.
No. 12 Very coarse powder	Powder has a fineness, in diameter of particles, less than	1.47 millimeters.
No. 6	Powder has a fineness, in diameter of particles, less than	3.00 millimeters.

The degrees of fineness defined above shall be such as are determined by sieving tests made with sieves of the Standard Screen Scale recommended by the Bureau of Standards."

For very fine powders, bolting cloth is used for the sifting medium; and when acid substances are to be sifted, horsehair sieves are used.

Levigation is the process of reducing substances to a state of minute division by triturating them after they have been made into a paste with water or other liquid. This is effected in a shallow mortar with a flat surfaced pestle, or upon a ground glass slab with a flat surfaced glass muller (see Fig. 260). The motion imparted to the muller, A, closely resembles the figure 8; this is frequently varied with that of elongated circles which intersect each other, the object being to vary the motion so that all particles of the powder may be brought under the action of the muller upon the slab G. Certain substances, like red mercuric oxide and zinc oxide, if made

FIG. 260

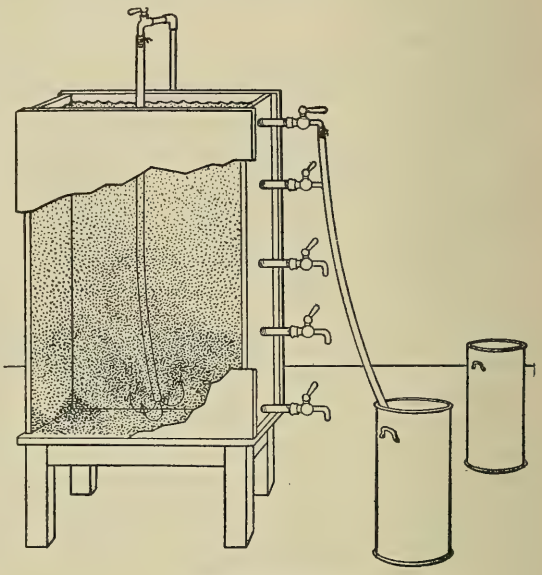


Slab and muller

into a paste with alcohol or water, are more readily reduced to fine powder in this way than by the action of the mortar and pestle. The process is termed *porphyrization* when performed with a porphyry slab and muller.

Elutriation is the process of obtaining a substance in fine powder by suspending an insoluble powder in water, allowing the heavier particles to fall to the bottom of the vessel, and decanting the liquid containing the lighter particles into another vessel, and there collecting them. It is *water sifting* practically, wherein the superior gravity of the larger particles is used as a means of separating them from the smaller. Fig. 261 illustrates elutriation. The stopcocks on the side of the tank are intended to be used for drawing off a portion of the liquid after the heavier particles have subsided; this liquid may be transferred to another tank to finally permit the fine particles to settle. Prepared chalk is a familiar illustration of an elutriated powder.

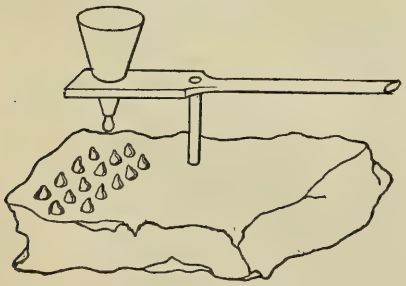
Fig. 261



Elutriating apparatus

Trochiscation is the process of making the pasty mass or magma obtained by elutriation into dry, conical masses. This is usually accomplished by the use of the little apparatus shown in Fig. 262. This consists of a tinned iron cone, supported in a circular wooden frame which has one short wooden leg and a handle. A slab of chalk or other porous substance is provided, and after filling the cone with the pasty mass the handle is taken in the hand and the leg of the frame is tapped gently upon the slab of chalk. The shock causes a conical mass of the substance to fall upon the slab, whereupon the moisture present soon becomes absorbed, so that the little cone dries quickly. A succession of taps, with a slight lateral movement, deposits the cones in regular rows, and when

Fig. 262



Trochiscator

the slab is full the first cones are found to be dry enough to be transferred, and all will soon be in the same condition. Chalk, bismuth, lake, and other insoluble powders are formed into conical nodules in this way.

Pulverization by intervention is the process of reducing substances to powder through the use of a foreign substance, from which the powder is subsequently freed by some simple method. No general process can be given for this method of pulverization, as the character of the substance must determine the method. The metal gold may be powdered by rubbing gold leaf in a mortar in contact with potassium sulphate. The latter is subsequently dissolved out with water. Camphor may be pulverized through the addition of a few drops of alcohol, chloroform, or other solvent. The foreign substance in this case is disposed of through evaporation. Metallic tin may be granulated by melting it and agitating it in a box containing powdered chalk. The latter is subsequently dissolved out with diluted acetic acid. Phosphorus may be pulverized by placing it in water contained in a small flask, then heating the water gradually until the phosphorus is melted, and shaking the flask while the phosphorus is cooling. The agitation in the presence of water keeps the particles from cohering.

QUESTIONS ON DESICCATION AND COMMINUTION

What is desiccation? (See page 184.) What are the objects of desiccation?
How may roots, herbs, and leaves be conveniently dried on the large scale?
What is meant by "gruffs"? What use is made of "gruffs"?
Why is myrrh in substance and not in fine powder directed for making tincture of myrrh?
What is comminution? (See page 189.) What are the objects of comminution?
How may roots, barks, etc., be conveniently cut? How upon the large scale?
How may drugs be most conveniently bruised or contused?
When it becomes necessary to use an iron mortar and pestle for a considerable length of time, how may the labor of lifting the pestle be lessened?
For what purposes are wooden mortars used?
For what purposes are marble mortars used?
In using marble mortars, what precautions are necessary?
What is the difference between grinding and pulverizing?
What drugs are most injured by drying?
What is a buhrstone mill?
What two varieties are there, and what are they called?
What is the peculiarity of each?
What are roller mills? What are the rollers usually made of?
What is the form of the rollers?
What are chaser mills? How are the stones arranged?
How are powders of greater or less degrees of fineness obtained from chaser mills?
What is a "jar mill" or a "pebble mill"? For what kind of grinding is it used?
What are barrel mills?
How is the "Bogardus" mill constituted, and what is its peculiarity?
What is Mead's disintegrator? What is requisite in running this mill?
Describe the Max mill. What three classes of hand mills are there?
Describe Swift's mill (old style).
What improvements have been made in the new style Swift's mill?
Describe Troemner's mill Describe the Enterprise mill. What are its advantages?
Describe the Quaker City mill and what are its advantages?
Describe Thomas's mill. What are the principle objections to this mill?
Describe Swift's B mill. Describe Hance's mill.
Is Hance's mill best adapted for light or heavy work?
What are the most usual difficulties met with in operating hand mills?
How may these be obviated?
What is a good method of cleaning a mill after an odorous drug has been ground?
What is trituration?
What shaped mortars and pestles are best adapted to the purpose of trituration?
What objection is there to the ordinary pestle of porcelain or wedgwood mortars?
How is this best remedied?
Is the hard-rubber handle any better, and if so, why?
What preparation, called a "trituration," is official in the U. S. P.?
Describe a device for facilitating trituration.
What is the objection to glass mortars and pestles?
Which are most useful,—mortars and pestles of porcelain, white glass, or green glass, and why?
What is a spatula, and what is its best form?
For what are hard rubber spatulas useful?
How is the process of sifting accomplished?
Why is it important to thoroughly mix powders which have been ground and sifted?
Describe Jones's mixer and sifter. Describe Hunter's sifter.
How are the degrees of fineness of powders designated in the U. S. P.?
How many degrees of fineness are so designated?
What is meant by a very fine powder? Fine powder? Moderately fine powder? Moderately coarse powder? Coarse powder? Very coarse powder?
In some special cases other degrees of fineness than these five are designated, as for example, No. 30 and No. 6: What is meant by these numbers?
For what is a horse hair sieve used?
When should bolting cloth be used as the sifting medium?
What is levigation? What is meant by porphyrization? By elutriation?
Give an example of an elutriated powder. What is trochiscation?
What is pulverization by intervention? Give an example of this process.

CHAPTER IX

SOLUTION

Solution.—In pharmacy this term is applied to the process whereby any substance, sometimes called a *solute,* is liquefied or made to disappear when brought in contact with a liquid. The particles of the substance being uniformly diffused through the liquid, no separation takes place upon standing. The liquid used to effect this change is called a *solvent,* and, after its combination with the dissolved substance, a *solution;* if the liquid has exercised its powers as a solvent to its utmost extent, and is incapable of retaining any more of the dissolved substance, it is termed a *saturated solution.* A substance which is not acted on by a solvent is said to be *insoluble.*

Solution of Solids.—This is an operation which is very frequently performed by the pharmacist. In this place only the methods of effecting the solution of solid bodies which can be entirely dissolved in the solvent will be noticed. This excludes the operations of Infusion, Decoction, Percolation, Maceration, etc., which will be considered at length in subsequent chapters. Solution may be of two kinds : 1, Simple ; 2, Chemical.

1. Simple Solution is where the solid suffers no alteration on being dissolved, except that which depends upon its external form, and where, if the reverse operation of evaporation is applied, the solid substance is recovered unchanged. The making of syrup is an example.

2. Chemical Solution is where the properties of the dissolved body are changed by the chemical action of the solvent or some of the substances added, and the simple process of evaporation results in the production of a body having different properties, as, for example, in the official solution of mercuric nitrate.

Effects of Pulverization and Agitation.—The solution of solids may be facilitated by pulverizing them and stirring the mixture, thus increasing their extent of surface and promoting the frequent contact of the surfaces with fresh portions of the solvent. This is easily illustrated, as already noted in the chapter on Comminution, by placing half an ounce of lump alum and half an ounce of powdered alum each in a separate pint of water at the same time. A few vigorous stirs will soon cause the latter to dissolve, while the former will require a much longer time.

Effect of Heat.—The application of heat generally favors solubility, for nearly all substances are more soluble in hot liquids than in cold ones. In addition to this, the convection currents in the liquid caused by heat hasten the solution by constantly bringing fresh surfaces into contact with the liquid. In many cases the ratio of solubility is not the same for equal increments of heat.

Density of Solutions.—The effect of dissolving a solid body, specifically heavier than the solvent, is always to increase the density of the liquid in which the solid is dissolved. The specific gravity of water is 1.000. If 5 per cent. of sugar is dissolved in it, the specific gravity is 1.021; if 10 per cent., 1.070; if 20 per cent, 1.088, etc. This fact is capable of optical proof; for if a piece of sugar is suspended near the top of some water in a beaker, the downward currents of the solution can readily be noticed if viewed by transmitted light.

Solubility of Substances in Saturated Solutions.—While a saturated solution is one which is incapable of dissolving any more of the substance which was dissolved in the liquid, it must not be assumed that the saturated solution will not dissolve *other* solids. For example, if granulated potassium nitrate be mixed with 2 per cent. of copper sulphate, and then placed in a funnel having a plug of cotton in the throat, it will be found that the copper sulphate can be very easily removed by pouring on the potassium nitrate mixture a *saturated solution* of potassium nitrate. The potassium nitrate cannot suffer loss, because the liquid passing through is a saturated solution of the same substance; but copper sulphate is soluble in a saturated solution of potassium nitrate, and it is thus washed out.

Reduction in Temperature caused by Rapid Solution.—When solids dissolve rapidly in liquids without chemical action, a reduction in temperature always takes place, and cold is produced, in accordance with the well known law governing the conversion of solids into liquids, whereby sensible heat is converted into latent heat. The so-called freezing mixtures are produced in this way. Thus, if 5 parts of potassium sulphocyanide are quickly mixed with 4 parts of cold water, the temperature of the solution falls to —20° C. (—4° F.); 32 parts of sodium chloride, if mixed with 100 parts of snow, will produce a brine having a freezing point of —23° C. (—9.4° F.). Equal parts of crystallized calcium chloride and snow, when well mixed, will have a temperature as low as —45° C. (—49° F.).

Elevation of Temperature produced by Solution accompanied by Chemical Action.—If chemical action takes place while solution is progressing, the opposite effect, or elevation of temperature, is frequently produced, as in dissolving anhydrous salts. The same fact is noticed when the solution of an alkaline oxide made by calcination is effected by treating it with an acid, as when calcined magnesia is dissolved in a solution of citric acid.

Modes of effecting Solutions of Solids.—The method usually employed by the pharmacist is one which requires the use of the solution mortar and pestle (see Fig. 246). The ordinary practice is to crush the substance into fragments in the mortar with the pestle, and then pour upon it the solvent, meanwhile stirring with the pestle until solution is effected. If definite quantities are used, and the whole of the solvent is required to dissolve the given weight of the salt, a portion only of the solvent should be added at first, and when this is saturated the solution is poured off and a fresh portion of solvent added. This operation is repeated until the solid is entirely dissolved; the solutions are then mixed. Other methods of effecting

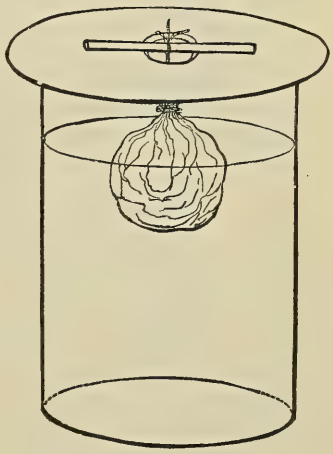
solution are to shake the solid with the liquid in a bottle or flask, or to apply heat to the substances in a suitable vessel.

The *Solubility* of chemicals or miscibility of liquids is an important physical factor for the pharmacist, inasmuch as it often has a bearing upon the filling of prescriptions. Mainly for the information of the pharmacist the U. S. P. has given figures to indicate the degree of solubility or miscibility of the various official substances.

Circulatory Solution.—A very excellent mode of dissolving substances, particularly where the solid is not very soluble or the relative proportion of liquid is small, is to suspend the solid near the top of the liquid upon a porous diaphragm or a suitable sieve, or tied up in a gauze bag if its nature will admit of this treatment. The substance immediately in contact with the solvent is dissolved, and the solution descends, its place being supplied by fresh portions of the solvent. A circulation is thus created and solution facilitated (see Fig. 263).

Solvents used in Pharmacy.—*Water.* The most useful of all solvents is water. It has a more extensive range than any other liquid, and the aqueous solutions are among the most important preparations of pharmacy. They are especially treated of in the following chapters, under the heads of Liquores, Aquæ, Syrupi, etc.

Fig. 263



Circulatory solution

Alcohol, as a solvent, is next in importance to water. It has an important advantage over water in the fact that preparations made with it keep almost indefinitely, while most aqueous solutions of organic substances soon decompose or become worthless. Resins, volatile oils, alkaloids, glucosides, salts, etc., are dissolved by alcohol, while many inert principles, like gum, albumin, and starch, are insoluble in it, so that it has also great usefulness in its negative character.

Glycerin is an excellent solvent, although its range is not so extensive as either of the preceding. It has in its concentrated state antiseptic qualities of a high order, but has not the valuable negative qualities of alcohol. It dissolves the fixed alkalies, some of the alkaline earths, a large number of neutral salts, and vegetable acids, pepsin, tannin, etc., but it also dissolves gum, albumin, starch, etc., and thus its solutions are generally loaded with inert constituents. (See Glycerites.)

Ether is a good solvent for special purposes. Oils, fats, resins, and some of the alkaloids and neutral principles are dissolved by it.

Petroleum Benzin is very similar in its solvent properties to ether.

Chloroform resembles ether and petroleum benzin as a solvent. It has an advantage over both, however, in not being inflammable.

Benzene obtained from the distillation of coal tar like ether is a good solvent for many substances.

Acetone is a good solvent for resins, oils, etc., and was used in the U. S. P. VIII in making oleoresins.

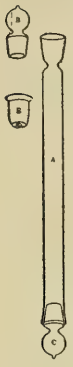
Carbon Disulphide is an excellent solvent for rubber, phosphorus, etc. Its range is limited, however, and its odor and inflammability detract from its usefulness.

Acids, either strong or diluted, are used as solvents, as in vinegars.

Oils are also used in this way in liniments, etc.

Solubility as a Test.—The solubility of a substance in various solvents constitutes a factor whereby its identity and purity can, in some degree, be determined, but the U. S. P. IX has recognized the fact that the degree of solubility of the various official substances is primarily valuable as information required by physicians and pharmacists in connection with the preparation and dispensing of medicines. The U. S. P. makes the following statement concerning solubility as a physical factor.

FIG. 264



Rice's lysimeter

"The following points must be observed in the accurate determination of solubilities: 1. Purity of both the dissolved substance and solvent is essential since impurities in either affect the solubility to a greater or less extent. 2. The constancy of the temperature must be accurately maintained during the course of the determination. 3. Complete saturation must be secured. 4. Accurate analysis of the saturated solution and correct expression of the results are imperative. In connection with the above named essential features of a correct solubility determination, attention should be called to the varying rates of solution of different compounds and to the marked effect of the degree of fineness of the particles upon the time required for the saturation of the solution. In general, it may be said that an equipment comprising a thermo-regulator and a constant agitation device is indispensable for accurate solubility determinations. The solubility of Pharmacopœial compounds in given solvents is considered to be of minor importance as a means for their identification or quantitative estimation, as the other tests contained in the description of each article in the text cover both identity and purity.

"The solubility data given throughout the Pharmacopœia have for the most part been determined under the above described conditions, and will, therefore, frequently show a somewhat greater solubility than would be found in the daily experience of most pharmacists.

"Solubility figures are inserted in the text as information to serve as a convenient aid in determining identity and purity approximately and are not intended to be construed as legal requirements, except in the case of volatile oils where solubilities in alcohol of different strengths are used as tests for purity. The subject of solubilities will be found under a special chapter in Part II.

"In testing for solubility, slight mechanical impurities, such as fragments of filter paper, fiber, dust particles, permitted by other tests for the same substance but which slightly interfere with the transparency of the solution, are not to be construed as vitiating the test for solubility.

"*Method for Determining Solubilities.*—In brief, this consists in preparing a saturated solution of the given substance and ascertaining,

by analysis, the amount present in a definite quantity of the solution. Complete saturation can be attained most readily by constant stirring or agitation by means of a suitable mechanical contrivance. A simple apparatus for this purpose consists of a test tube of medium size fastened upright in a water bath maintained at constant temperature. The solvent and excess of solids are placed in the tube and stirred by means of a motor-driven rotating glass spiral. After a given period of stirring a definite weight of the clear solution is analyzed and the stirring continued for an additional period of several hours. If analysis shows no increase of dissolved substance after the second period of stirring, the result is to be taken as the solubility at the particular temperature. Minute details of methods for determining solubilities are described in Bulletin No. 67 of the Hygienic Laboratory, U. S. Public Health Service."

The U. S. Pharmacopœia indicates the degree of solubility of a chemical substance by stating the number of mils of solvent which will be required to dissolve 1 Gm. of the substance. The temperature at which solution is to be effected is frequently given; in other cases such terms as "readily soluble" or "sparingly" are used.

For taking the solubility of substances in hot solvents, Dr. Rice devised an ingenious instrument which he called a lysimeter (see Fig. 264).

Table of the Solubility of Official Substances in Water and in Alcohol

Abbreviations: sol. = soluble; ins. = insoluble; v. sl. = very slightly; sl. = slightly; sp. = sparingly; v. s. = very soluble; alm. = almost; dec. = decomposed; fr. = freely; r. s. = readily soluble; p. s. = partially soluble; misc. = miscible.

One Gm. Dissolves	In mils of Water		In mils of Alcohol	
	At 25° C. (77° F.)	Boiling	At 25° C. (77° F.)	Boiling
	Mils	*Mils*	*Mils*	*Mils*
Acetanilidum	190	20	3.4	0.6
Acetphenetidinum	1310	82	15	2.8
Acidum Benzoicum	275	18	2.3	1.5
Boricum	18	4	18	—
Citricum	0.5	0.5	1.8	—
Gallicum	87	3	4.6	—
Acidum Phenylcinchoninicum	ins.	sl. sol.	sl. sol.	r. s.
Salicylicum	460	15	2.7	—
Stearicum	alm. ins.	alm. ins.	21	—
Tannicum	v. s.	v. s.	v. s.	v. s.
Tartaricum	0.75	0.5	3.3	—
Trichloraceticum	0.1	—	v. s.	—
Aconitina	v. sl. sol.	—	28	—
Adeps	ins.	ins.	v. sl. sol.	—
Lanæ	ins.	—	sp. sol.	more sol.
Æther	12	—	misc.	misc.
Æthylis Carbamas	0.45	—	0.8	—
Æthylmorphinæ Hydrochloridum	8	—	22	—
Aloinum	sol.	—	sol.	—
Alumen (Potassium)	7.2	0.3	ins.	ins.
Exsiccatum	20	1.5	ins.	ins.
Alumini Hydroxidum	ins.	ins.	ins.	ins.
Ammonii Benzoas	10	—	35.5	—
Bromidum	1.3	0.9	12	1.2
Carbonas	4	dec.	dec.	dec.
Chloridum	2.6	1.4	100	—
Iodidum	0.6	0.5	3.7	—
Salicylas	1	—	3	—
Valeras	0.3	—	0.6	—

Solubility of Official Substances in Water and in Alcohol—*Continued.*

One Gm. Dissolves	In mils of Water		In mils of Alcohol	
	At 25° C. (77° F.)	Boiling	At 25° C. (77° F.)	Boiling
	Mils	*Mils*	*Mils*	*Mils*
Amylis Nitris	alm. ins.	—	misc.	—
Antimonii et Potassii Tartras	12	3	ins.	—
Antipyrina	1	—	1.3	—
Apomorphinæ Hydrochloridum	50	17 (80° C.)	50	—
Argenti Nitras	0.4	0.1+	30	6.5
Nitras Fusus, 5 per cent. (AgCl) ins.	0.4	0.1+	30	6.5
Oxidum	v. sl. sol.	v. sl. sol.	ins.	ins.
Arseni Iodidum	12	—	sol.	—
Arseni Trioxidum	sol.	—	sl. sol.	—
Atropina	455	90 (80° C.)	2	1.2 (60°C.)
Atropinæ Sulphas	0.4	—	5	2.5
Auri et Sodii Chloridum	v. s.	—	$AuCl_3$ sol.	—
Balsamum Peruvianum	—	—	sol.	—
Balsamum Tolutanum	alm. ins.	—	sol.	—
Benzaldehydum	sl. sol.	—	misc.	—
Benzinum	ins.	—	fr. sol.	—
Benzosulphinidum	290	25	31	—
Betaeucainæ Hydrochloridum	30	more sol.	35	more sol.
Betanaphthol	1000	80	0.8	—
Bismuthi Betanaphtholas	alm. ins.	alm. ins.	alm. ins.	alm. ins.
et Ammonii Citras	v. s.	v. s.	sp.	sp.
Subcarbonas	ins.	ins.	ins.	ins.
Subgallas	ins.	ins.	ins.	ins.
Subnitras	alm. ins.	alm. ins.	ins.	ins.
Subsalicylas	alm. ins.	—	—	—
Bromoformum	sl. sol.	—	misc.	—
Caffeina	46	5.5 (80° C.)	66	22 (60°C.)
Caffeinæ Sodio-Benzoas	1.1	—	30	—
Calcii Brominum	0.7	0.4	1.3	—
Carbonas Præcipitatus	alm. ins.	alm. ins.	ins.	ins.
Chloridum	0.62	0.7	10	2
Glycerophosphas	50	—	ins.	—
Hypophosphis	6.5	—	ins.	—
Lactas	20	—	alm. ins.	—
Sulphidum Crudum	v. sl. sol.	more r. s.	ins.	—
Calx	840	1740	ins.	—
Chlorinata	p. s.	—	p. s.	—
Camphora	sl. sol.	—	fr. sol.	—
Camphora Monobromata	alm. ins.	—	6.5	—
Cera Alba	ins.	—	sp. sol.	dec.
Flava	ins.	—	sp. sol.	dec.
Cerii Oxalas	ins.	ins.	ins.	ins.
Cetaceum	ins.	—	alm. ins.	sol.
Chloralum Hydratum	0.25	—	1.3	—
Chromii Trioxidum	0.6	0.5	dec.	dec.
Chrysarobinum	v. sl. sol.	v. sl. sol.	385	—
Cinchonidinæ Sulphas	65	22 (80° C.)	90	41 (60° C.)
Cinchoninæ Sulphas	60	33 (80° C.)	12.5	7 (60° C.)
Cocaina	600	270 (80°C.)	6.5	v. sol. (warm)
Cocainæ Hydrochloridum	0.4	—	3.2	2 (60° C.)
Codeina	120	—	2	1.2(60°C.)
Codeinæ Phosphas	2.3	0.5(80°C.)	325	125
Codeinæ Sulphas	30	6.5 (80° C.)	1280	440(60°C.)
Colchicina	22	21(80° C.)	fr. sol.	—
Cotarninæ Hydrochloridum	v. s.	—	v. s.	—
Creosoti Carbonas	ins.	—	fr. sol.	—
Creosotum	sl. sol.	—	misc.	—

Solubility of Official Substances in Water and in Alcohol—*Continued.*

One Gm. Dissolves	In mils of Water		In mils of Alcohol	
	At 25° C. (77° F.)	Boiling	At 25° C. (77° F.)	Boiling
	Mils	*Mils*	*Mils*	*Mils*
Cresol	50	—	misc.	—
Creta Præparata	alm. ins.	alm. ins.	ins.	ins.
Cupri Sulphas	2.5	0.5	500	—
Diacetylmorphina	1700	—	31	—
Diacetylmorphinæ Hydrochloridum	2	—	sol.	—
Diastasum	sol.	—	alm. ins.	—
Elaterinum	ins.	ins.	325	100
Emetininæ Hydrochloridum	fr. sol.	—	fr. sol.	—
Eucalyptol	v. sl. sol.	—	misc.	—
Eugenol	—	—	misc.	—
Ferri Chloridum	0.2	—	fr. sol.	—
et Ammonii Citras	r. s.	r. s.	ins.	ins.
et Quininæ Citras	r. s.	—	p. s.	—
Phosphas	fr. sol.	fr. sol.	ins.	ins.
Sulphas	1.4	0.4	ins.	ins.
Sulphas Exsiccatus	slowly sol.	—	ins.	ins.
Sulphas Granulatus	1.4	0.4	ins.	ins.
Ferrum Reductum	ins.	—	ins.	—
Gelatinum	ins.	s.	ins.	ins.
Glucosum	v. s.	—	sp. sol.	—
Glycyrrhizinum Ammoniatum	fr. sol.	—	sol.	—
Guaiacol	53	—	misc.	—
Guaiacolis Carbonas	ins.	ins.	60	fr. sol.
Hexamethylenamina	1.5	—	12.5	—
Homatropinæ Hydrobromidum	6	—	40	12(60°C.)
Hydrargyri Chloridum Corrosivum	13	2.1	3.8	1.6
Chloridum Mite	ins.	ins.	ins.	ins.
Iodidum Flavum	alm. ins.	alm. ins.	ins.	ins.
Iodidum Rubrum	alm. ins.	alm. ins.	115	20
Oxidum Flavum	alm. ins.	alm. ins.	ins.	ins.
Oxidum Rubrum	alm. ins.	alm. ins.	ins.	ins.
Salicylas	nearly	—	nearly	—
Hydrargyrum Ammoniatum	ins.	ins.	ins.	ins.
Hydrastina	alm. ins.	—	170	22(60° C.)
Hydrastinæ Hydrochloridum	v. s.	—	v. s.	—
Hydrastininæ Hydrochloridum	v. s.	—	v. s.	—
Hyoscyaminæ Hydrobromidum	v. s.	v. s.	2.5	—
Iodoformum	nearly ins.	—	60	16
Iodum	2950	—	12.5	—
Lithii Bromidum	0.6	0.4	fr. sol.	—
Carbonas	78	140	alm. ins.	—
Citras	1.4	—	v. sl. sol.	—
Magnesii Carbonas	ins.	ins.	ins.	ins.
Oxidum	alm. ins.	alm. ins.	ins.	ins.
Oxidum Ponderosum	alm. ins.	alm. ins.	ins.	ins.
Sulphas	1	0.2	alm. ins.	—
Mangani Dioxidum Præcipitatum	ins.	ins.	ins.	ins.
Menthol	sl. s.	—	v. s.	—
Methylis Salicylas	sp. s.	—	misc.	—
Methylthioninæ Chloridum	fr. sol.	—	fr. sol.	—
Morphina	3340	1075	210	98
Morphinæ Hydrochloridum	17.5	0.5	52	46(60°C.)
Morphinæ Sulphas	15.5	0.7 (80° C.)	565	240 (60° C.)
Nitrogenii Monoxidum	1 vol. water at 25° C dissolves 1.3 vol. N_2O			
Oxygenium, 1 vol. in	34	—	3.6	—
Pancreatinum	slowly and incompletely sol.	—	ins.	—

Solubility of Official Substances in Water and in Alcohol—*Continued.*

One Gm. Dissolves	In mils of Water		In mils of Alcohol	
	At 25° C. (77° F.)	Boiling	At 25° C. (77° F.)	Boiling
	Mils	*Mils*	*Mils*	*Mils*
Paraffinum	ins.	ins.	ins.	ins.
Paraformaldehydum	slowly sol.	more r. s.	ins.	—
Paraldehydum	8	17	misc.	—
Pelletierinæ Tannas	240	—	16	—
Pepsinum	50	—	nearly ins.	—
Petrolatum	ins.	—	alm. ins.	alm. ins.
Petrolatum Liquidum	ins.	—	ins.	—
Phenol	15	—	v. s.	—
Liquefactum	—	—	misc.	—
Phenolphthaleinum	alm. ins.	—	13	—
Phenylis Salicylas	6670	—	6	—
Phosphorus	alm. ins.	—	400 (dehydrated alc.)	—
Physostigminæ Salicylas	75	16 (80° C.)	16	5
Pilocarpinæ Hydrochloridum	0.3	—	3	—
Nitras	4	—	75	21 (60° C.)
Plumbi Acetas	1.4	0.5	38	—
Oxidum	alm. ins.	alm. ins.	ins.	ins.
Potassa Sulphurata	v. s.	—	dec.	—
Potassii Acetas	0.5	0.2	2.9	—
Bicarbonas	2.8	2 (50° C.)	alm. ins.	—
Bitartras	155	16	8820	—
Bromidum	1.5	1	250	21
Carbonas	0.9	0.7	ins.	—
Chloras	11.5	1.8	ins.	—
Citras	0.6	—	alm. ins.	—
et Sodii Tartras	0.9	—	alm. ins.	—
Hydroxidum	0.9	0.6	3	v. s.
Hypophosphis	0.6	0.4	9	5
Iodidum	0.7	0.5	22	8
Nitras	2.8	0.5	620	—
Permanganas	13.5	3.5	dec.	dec.
Pyrogallol	1.7	v. s.	1.3	v. s.
Quinina	1560	800	0.8	—
Quininæ Bisulphas	9	0.7	23	0.7(60° C.)
Dihydrochloridum	0.6	—	12	—
et Ureæ Hydrochloridum	0.9	—	2.4	—
Hydrobromidum	40	3.2 (80° C.)	0.9	—
Hydrochloridum	18	0.5 (80° C.)	0.8	—
Salicylas	sl. sol.	—	14	—
Sulphas	725	47 (80° C.)	107	12 (60°C.)
Tannas	sl. sol.	—	more sol.	—
Resorcinol	0.9	0.2 (80° C.)	0.9	—
Saccharum	0.5	0.2	170	—
Lactis	4.9	2.6	alm. ins.	—
Salicinum	23.5	3.3 (80° C.)	88.5	30(60° C.)
Santoninum	sl. sol.	sl. sol.	43	6.5
Sapo	sol.	—	sol.	—
Scopolaminæ Hydrobromidum	1.5	—	20	—
Sevum Præparatum	ins.	—	ins.	44
Sodii Acetas	0.8	—	19	—
Arsenas	1.5	1	sl. sol.	nearly ins.
Arsenas Exsiccatus	3.1	1.3	sl. sol.	nearly ins.
Benzoas	1.8	1.4	61	—
Benzosulphinidum	1.2	—	50	—
Bicarbonas	10	—	ins.	—

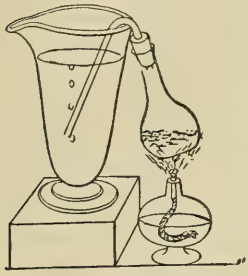
Solubility of Official Substances in Water and in Alcohol—*Continued.*

One Gm. dissolves	In mils of Water		In mils of Alcohol	
	At 25° C. (77° F.)	Boiling	At 25° C. (77° F.)	Boiling
	Mils	*Mils*	*Mils*	*Mils*
Sodii Boras	15	0.6	ins.	—
Bromidum	1.1	—	16	—
Cacodylas	0.5	—	2.5	—
Carbonas Monohydratus	3	1.8	ins.	—
Chloridum	2.8	2.7	sl. sol.	—
Citras	1.3	0.6	ins.	—
Cyanidum	fr. sol.	—	—	—
Glycerophosphas	v. s.	v. s.	nearly ins.	nearly ins.
Hydroxidum	0.9	0.3	v. s.	—
Hypophosphis	1	0.15	sol.	fr. sol.
Indigotindisulphonas	sp. sol.	—	alm. ins.	—
Iodidum	0.55	0.4	2	—
Nitris	1.5	v. s.	sp. sol.	—
Perboras	sol.	—	—	—
Phenolsulphonas	4.2	0.8	140	13.5
Phosphas	2.7	—	ins.	—
Phosphas Exsiccatus	8.1	1.1	ins.	—
Salicylas	0.9	v. s.	9.2	v. s.
Sulphas	1	—	ins.	—
Sulphis Exsiccatus	3.2	—	sp. sol.	—
Thiosulphas	0.5	dec.	ins.	—
Sparteinæ Sulphas	1.1	—	3	—
Strontii Bromidum	0.35	—	sol.	—
Iodidum	0.2	—	sol.	—
Salicylas	19	3.7	61	14
Strophanthinum	v. s.	—	v. s.	—
Strychnina	6400	3100	Dil. Alc. 136	34
Strychninæ Nitras	42	9	150	77(60° C.)
Sulphas	32	7	81	26(60° C.)
Styrax	ins.	—	1 (warm)	—
Sulphonethylmethanum	200	more sol.	sol.	—
Sulphonmethanum	365	16	60	3
Sulphur Lotum	ins.	ins.	nearly ins.	—
Præcipitatum	ins.	ins.	nearly ins.	—
Sublimatum	ins.	ins.	nearly ins.	—
Terebenum	sl. sol.	—	3	—
Terpini Hydras	200	34	13	3
Theobrominæ Sodio-Salicylas	1	—	sl. sol.	—
Theophyllina	100	r. s.	80	—
Thymol	1010	—	1	—
Thymolis Iodidum	ins.	—	sl. sol.	—
Trinitrophenol	78	15	12	—
Uranii Nitras	1.2	—	fr. sol.	—
Vanillinum	100	16 (80° C.)	fr. sol.	—
Veratrina	1760	1345(80° C.)	2.8	—
Zinci Acetas	2.3	1.6	30	1
Carbonas Præcipitatus	ins.	ins.	ins.	ins.
Chloridum	0.25	—	1.3	—
Oxidum	ins.	ins.	ins.	ins.
Phenolsulphonas	1.6	0.4	1.8	—
Stearas	ins.	ins.	ins.	ins.
Sulphas	0.6	—	ins.	—
Valeras	70	—	22	—

Solution of Gases in Liquids

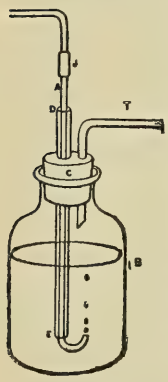
The methods employed to effect the solution of gases in liquids differ essentially from ordinary processes of solution, and depend upon the solubility of the gas in the liquid, the relative specific gravity, and the strength of the solution desired. It is usually sufficient to conduct the gas into the liquid by a suitable tube, reaching nearly to the bottom, when more or less of the gas is absorbed by the liquid. Fig. 265 shows a simple method where the gas is readily soluble in the liquid, as in making chlorine water. For a continuous operation, as in making hydrochloric, nitric, and hydrobromic acids, and similar liquids, the well-known Woulfe's, or three-necked bottles are employed advantageously, the gas which escapes solution in one bottle passing over into the next. The washing bottle shown in Fig. 266 is easily made, and well adapted for purifying the gas after it is generated. B is an ordinary wide-mouthed bottle, closed with a perforated rubber cork, C; a wide tube, D E, passes nearly to the bottom, and a narrow tube, A, is joined by a short piece of rubber tubing, J, to the tube leading from the generating flask, and at the other extremity is curved upward so as properly to deliver the gas into the water placed in the bottle to wash it. It escapes by the bent tube, T, which is continued until it dips into the liquid in which the gas is to be dissolved. The space between the tube A and the wide tube D E acts as a safety valve. If the pressure accumulates through the too rapid generation of the gas, or if a stoppage occurs in the delivery tube, the liquid in the bottle is first blown out through this space, and the pressure is thus relieved.

Fig. 265



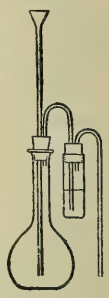
Method of absorbing gas

Fig. 266



Wash bottle

Fig. 267



Gas generator

Fig. 267 shows a very convenient little apparatus for generating and washing small quantities of gases, for testing, or other purposes. As the apparatus suitable for each operation must be especially selected, general observations on the solution of gases will not be so useful in this chapter as a detailed process in connection with each preparation where it is described in the subsequent pages. One general rule should be noted, however,—*i.e.*, that gases are generally more rapidly and thoroughly absorbed by cold liquids than by hot ones. Hence the receiving bottle should be kept surrounded by ice or otherwise refrigerated.

Colloidal Solutions.—In the chapter on Dialysis (see page 266) the general characteristics of colloids are discussed, but especially since the invention of the ultra-microscope by Zsigmondy and Siedentopf in 1905, with which colloidal solutions may be identified and differentiated from true solutions, they have assumed greatly increased importance. In current literature the colloidal solution is termed a "sol"

or "hydrosol" if water is the solvent, the solid, liquid or gas in colloidal solution a "gel," a "dispersed phase" or a "dispersoid," and the substance in which it is subdivided a "dispersion medium."

Colloidal solutions exhibit certain characteristics such as the so-called Brownian movement, a back and forth motion from a fixed central point, when viewed under the ultra-microscope. The solutions are usually clear and transparent when viewed with the unaided eye by transmitted light, but show turbidity or opalescence in reflected light. Electrically they show either a positive or negative charge and under certain conditions frequently gelatinize or deposit the colloidal substance as a sediment, the latter phenomenon being known as "flocculation." This condition is frequently brought about by disturbing influences, such as the presence of an electrolyte, *i.e.*, a chemical substance capable of ionization. Salt is an electrolyte, sugar is not. This explains why the addition of some substances tends to disturb emulsions while others do not. The separation of certain colloidal substances in a more or less gelatinous form has been termed pectisation, coagulation, precipitation or flocculation. These are only a few of the phenomena which characterize this condition of matter.

The importance of a study of colloids is evidenced by the recognition of their presence in many well known substances and processes. For instance, cheese is albumen colloidally dissolved in milk serum, the color of a ruby is due to minute quantities of chromium oxide in colloidal suspension in alumina, the tanning, ceramic, cement and other industries are based upon colloidal processes, the urine, blood and other body fluids are colloidal solutions. In medicine and pharmacy many applications have been made of the principles involved, probably the most important being the use of *colloidal silver*, which has proven to be a valuable antiseptic. The colloidal form of other metals has also been prepared and used, including gold, platinum, palladium, copper, selenium, iron, aluminum, etc., and many pharmaceutical preparations are said to be colloidal, particularly emulsions and mixtures.

QUESTIONS ON SOLUTION

What is meant by solution? (See page 211.)
What is the liquid used to make a solution called?
What is a saturated solution? When is a substance said to be insoluble? What two kinds of solution are there? Give examples of each.
How may the solution of solids be facilitated?
What is the effect of dissolving a solid body specifically heavier than the solvent? How may this be shown?
Is a saturated solution of one substance capable of dissolving some other substance?
When solids dissolve rapidly in liquids without chemical action, what takes place?
How are freezing mixtures made?
What is the effect if during the solution chemical action takes place?
How are solutions usually made by the pharmacist?
What is meant by circulatory solution?
Name the principle solvents used in pharmacy.
What are some of the advantages of alcohol as a solvent? Of glycerin?
For what substances is ether a good solvent? Indicate its advantage over chloroform.
What are objections to carbon disulphide as a solvent?
What value is the solubility of a substance as a test?
Does the temperature affect the solubility?
What is the U. S. P. standard temperature? Describe Rice's lysimeter.
Upon what do the methods for making solutions of gases in liquids depend?
Where a gas is freely soluble in a liquid, how is a solution usually affected?
What is the arrangement of a Woulfe's bottle? Are gases generally more rapidly and thoroughly dissolved by cold or hot liquids? What are colloidal solutions?

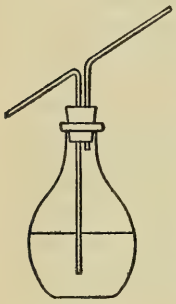
CHAPTER X

SEPARATION OF FLUIDS FROM SOLIDS

THE operations involved under this head are among those which are most frequently used in pharmacy,—*i.e.*, Lotion, Decantation, Colation, Filtration, Clarification, Expression, Percolation, etc.,—and the principles which govern the successful performance of these practical processes should be well understood. They are almost exclusively mechanical processes.

Lotion, or **Displacement Washing**, is the process of separating soluble matter from a solid by pouring a liquid upon it which will dissolve and wash out the soluble portion. The separation of the fluid from the solid is generally effected by placing an obstruction in a funnel or cylindrical vessel, such as a plug of cotton or tow, notched cork, filter paper, etc., and then, having introduced the solid into the funnel and arranged a suitable vessel beneath, the liquid is poured upon it. (See Percolation.) Precipitates are frequently purified from contaminating soluble matter in this way. A very convenient method of applying the liquid is by the use of the spritz bottle (see Fig. 268). This is usually made from a flask, but a round shouldered pint bottle of the diameter most easily grasped by the hand is preferable. Two glass tubes, one bent at an acute angle and the other at an obtuse angle, are used; one end of the former is drawn out to a capillary orifice, and the other extends nearly to the bottom of the bottle. The obtuse angled tube merely enters the bottle below the cork; the upper portion of this tube should be held in the gas flame, so as to fuse the edges of the glass and thus prevent cutting the lips when it is used. By filling the bottle with liquid, and blowing with the mouth through the tube, a stream of liquid is ejected from the capillary orifice which can be directed to any portion of a solid substance that is to be washed. It is often desirable, in order to save time, to use the liquid hot. One of the wicker covered bottles in which Farina cologne is imported answers a good purpose here to prevent burning the fingers, and if care is used to pour in a small quantity of hot liquid first and agitate it before adding the rest, so that the glass may be *gradually* warmed, there is no danger of fracturing the bottle.

FIG. 268

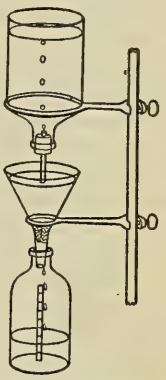


Spritz bottle

Continuous Washing.—The use of the spritz bottle for small operations is convenient. A simple method of automatically supplying the wash liquid in larger quantities is shown in Fig. 269. This requires no attention from the operator except at the beginning of the operation. The bottle is furnished with a perforated cork and a short glass tube. All that is necessary is to fill the bottle and adjust it over the funnel so that the end of the tube shall be at the height

desired for the liquid. On tilting the bottle slightly (if the tube selected is not too narrow in diameter) the liquid will run out into the funnel until it rises to the orifice of the tube, when the flow will cease. As the liquid gradually passes through the solid substance in the funnel, the level falls, and bubbles of air pass through the tube into the bottle, the liquid once more flows, and the operation continues until the bottle is empty. Many elaborate methods of continuous washing have been suggested, and many have been practically tried by the author, but if care is taken in the simple apparatus just described to have the tube of proper diameter, at least so wide that the force of capillary attraction shall not be strong enough to prevent the ingress of air, it is the most satisfactory of all. Bottles having narrow mouths may often be used in the same way, and the cork and tube be dispensed with. A little practice will enable the operator to make an apparatus in which the parts are adjusted to a nicety. On the large scale, Prof. B. S. Proctor's suggestion of two carboys may be used,—one above and inverted, containing the liquid, supported by a box having a circular hole cut in its side, and the other inside the box, containing the funnel and filter.

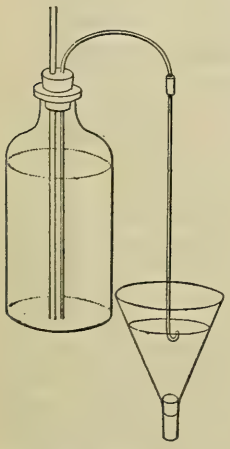
Fig. 269



Continuous washing

A modification of Gay Lussac's apparatus is one of the most successful and practical for continuous washing (see Fig. 270). The bottle containing the wash liquid is furnished with a doubly perforated cork and two glass tubes. One is bent as shown in the cut, and its lower extremity curved upward. By blowing a current of air through the other tube the syphon tube is filled, and the extremity may then be adjusted to such a height in the funnel as is desired. When the level of the liquid in the funnel falls below the orifice of the tube, bubbles of air will enter the bottle through the air tube, and the liquid will run out until it rises in the funnel to the level of the ends of the tubes, when it will cease. It will be found a practical convenience to cut the syphon tube just below the bend, so that a piece of rubber tubing may be used to form a flexible joint.

Fig. 270



Continuous washing apparatus

Decantation.—The process of separating a fluid from a solid by decantation is very simple, and consists usually of allowing the solid to deposit at the bottom of the vessel, and then carefully pouring off the liquid by inclining the vessel. The theory of washing by decantation shows its effectiveness, and this may be illustrated by the following example. If 360 grains of mercuric chloride dissolved in 50 fluidounces of water are mixed with 220 grains of potassium iodide dissolved in 50 fluidounces of water, double decomposition takes place, an insoluble precipitate of mercuric iodide subsides, and 100 grains of potassium chloride remain dissolved in

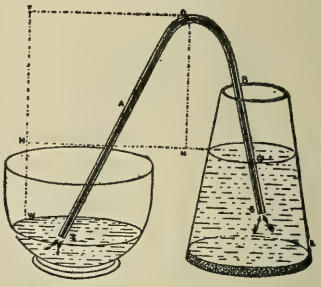
the 100 fluidounces of water. As it is desirable to free the mercuric iodide from the contamination of potassium chloride, the supernatant liquid is poured off; if 90 fluidounces are decanted, 90 grains, or $\frac{9}{10}$ of the whole quantity of potassium chloride, are thus disposed of, and 10 grains are left. If the vessel is filled with water to 100 fluidounces, and 90 fluidounces are again poured off, 9 grains are again removed, and but 1 grain is left; this by a third washing and decantation in a similar manner would be reduced to $\frac{1}{10}$ of a grain, and thus the purification is speedily effected. Some skill is required to decant liquids neatly from vessels of various shapes, particularly if they are not furnished with lips, or if filled nearly to the brim. The *guiding rod* may be used in many cases with effect. Indeed, it is a good practice to form the habit of using a stirrer or rod as a guide in decanting, as shown in Fig. 271, for it has a tendency to steady the hand of the operator. The practice recommended by some writers of greasing the rim of the vessel to facilitate decantation is a clumsy and usually unsuccessful expedient.

The Syphon (or **Siphon**).—It often happens in washing solid substances that decantation by pouring off the liquid cannot be successfully performed, either because the vessel is too full, or because, owing

Fig. 271

Use of the guiding rod

Fig. 272

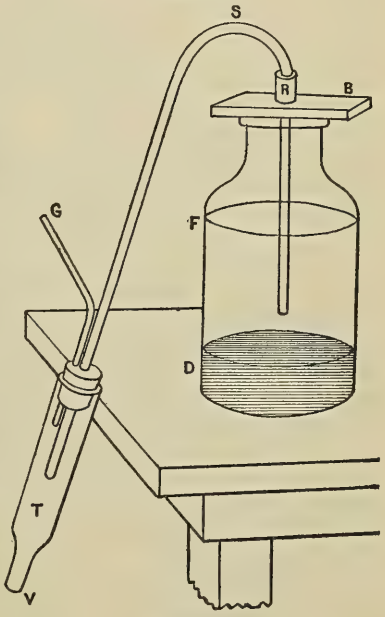


Syphon diagram

to the light character of the precipitate, the inclination of the vessel is sufficient to cause a disturbance in the powder, and an admixture of the liquid and solid. In such cases, and in many others, the useful instrument known as the syphon may be resorted to. This usually consists of a glass tube bent at a rather acute angle, and having one of the limbs longer than the other. It is used by filling the syphon with liquid, and then inserting the short limb into the liquid that is to be drawn off, when a flow of liquid from the long limb is established, which need not cease until as much of the liquid is abstracted as is desired. After filling the syphon the liquid may be prevented from running out (if a tube of small diameter is used) by stopping up the end of the long limb with the forefinger of the right hand, or, if the liquid to be drawn off is not caustic or unpleasant to the taste, the short limb of the syphon may be placed in the vessel at the proper height, and suction applied by the mouth at the long end until the current is established. The principle of the action of the syphon is

shown in Fig. 272. The combined lengths of the limbs of the syphon are not equal to the length of the glass tube, T O S, but the real syphon is only the tube acting between the levels of the liquid in the vessels. In all operations with the syphon there must be a difference in the levels of the liquid. In Fig. 272, O S represents the liquid in the short limb, and O T the liquid in the long limb. It is obvious that, if an equal limbed, narrow tube syphon is filled with liquid, and held level in liquid on the same plane, there can be no movement in the liquid ; equilibrium is established, because the tubes are equal in length and in level liquid, and the pressure of the air is the same upon all parts of the liquid. But the descending column of liquid in the long limb exceeds in weight that in the short limb, and it follows on account of the excess of weight of liquid in this limb that if it is once set flowing through the longer limb it will continue until the levels of the liquid in the two vessels are the same. It will be observed that the custom of having one limb longer than the other is not a necessity, for if there is sufficient difference between the levels of the liquid the syphon will operate with the position of the limbs reversed ; but it is a convenience in a syphon of unequal limbs always to immerse the short limb, as there is then the certainty that the other limb contains the longest column of liquid. The syphon, obviously, cannot be operated in a vacuum, nor if the length of the upward column of water exceeds thirty-three feet.

FIG. 273



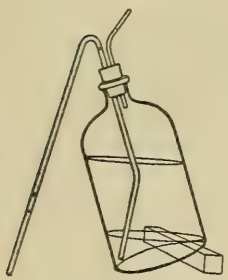
Syphon

Syphons for Special Purposes.— In the larger laboratory operations the most convenient syphon is made from a six-, eight-, or ten-foot length of rubber hose. This syphon, on account of its flexibility, can be used in many operations where glass or metal would be inconvenient or inadmissible, while its durability and simplicity of operation make it a necessity. Indeed, the utility of glass syphons is greatly increased by cutting the long limb just below the bend and joining it to the other by a piece of rubber tube.

The method, already referred to, of starting a syphon by applying suction with the mouth at the long end, or filling the syphon with liquid, is not always practicable, and various other expedients are in use. The *syphon with a bulbed lateral tube* is useful where caustic liquids are to be decanted. The finger is placed over the end of the long limb, and suction applied at the small tube until the downward current is started. Negretti's syphon has a glass syringe attachment upon the lower part of the long limb to accomplish the same purpose. Fig. 273

represents a modification of Mohr's syphon, the bottom having been cut from a Farina cologne bottle, T, by starting a cut with a three cornered file near the bottom and extending it around the surface with a red hot poker. The edges are now filed so that they are no longer sharp, and a cork is fitted and twice perforated to admit the longer limb of the syphon and a suction tube, G. It is started like the syphon with a lateral tube, the moistened forefinger closing the lower aperture, V, while suction is being used at G until the liquid has been started. A simple glass tube, with a short piece of rubber tube attached, is in practical hands an efficient substitute for elaborate contrivances to start the flow in a syphon; even if the liquid is caustic or disagreeable, there is no risk in careful hands if the rubber tube is held between the thumb and finger so that it can be instantly pinched tightly to prevent the upward flow of the liquid into the mouth.

Fig. 274



Syphon in bottle

Fig. 275

Syphon

Fig. 274 represents a form of syphon for drawing off the liquid to almost the last drop in the bottle. The shorter limb of the syphon is bent, and the syphon is started by blowing through the shorter tube in the cork. Fig. 275 shows a syphon with the shorter limb "turned up." This form has the advantage of retarding the tendency to empty itself, and, in syphoning the liquid from precipitates, there is not so much danger of stirring up the particles on the bottom.

Colation, or **Straining** (*colare*, to strain), is the process of separating a solid from a fluid by pouring the mixture upon a cloth or porous substance which will permit the fluid to pass through, but will retain the solid. This operation is frequently resorted to for separating sediment or mechanical impurities of various kinds from liquids. Gauze, fine muslin, cotton flannel, woollen felt, and other fabrics are used. Strainers are employed where the solid particles to be removed are not in very fine powder, or where complete separation is not especially desired.

Felt strainers are usually in the shape of felted, seamless, conical bags; the material is of wool and quite thick. They form excellent strainers for melted fats, petrolatum, wax, oils, syrups, elixirs, etc., where a large quantity of substance is to be strained. Their expensiveness is, however, an objection to their use, and the difficulty of cleaning them, owing to the tenacity with which they retain odors, unfits them for general use by the apothecary, but for special purposes in a manufacturing pharmacy they are very useful.

Fig. 276

Pattern for Hippocrates's sleeve

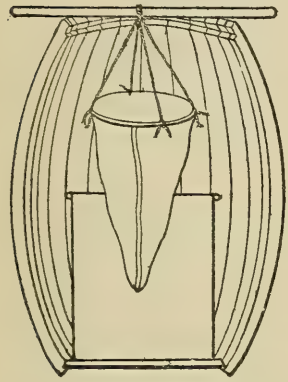
Fig. 277

Strainer, Hippocrates's sleeve

Woollen strainers made of twilled woollen cloth, flannel blanket material, etc., are more economical, because they can be cut to any

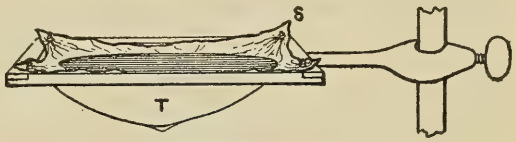
size desired, and the material costs less, while if the seams are closely sewed or overseamed they will last a long time. The form known as Hippocrates's sleeve (see Fig. 277) is that generally used. Fig. 276 shows the shape and dimensions before being sewed. A wooden hoop or brass ring is required to keep the opening extended. This should

Fig. 278



Use of strainer

Fig. 279



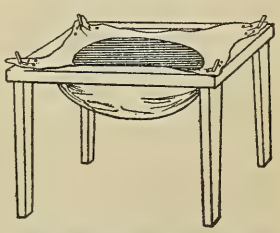
Cotton cloth strainer

be arranged so that it can be removed when the bag is to be washed. The most convenient support is a stick passed through the cords which are attached to the strainer, the whole suspended in a barrel arranged as shown in Fig. 278. The object of suspending it in the barrel is to avoid currents of air, which, in the case of many liquids, would cause evaporation from the surface and the formation of a crust, and thus impede the rapidity of colation. A tin or copper can of proper size may be placed in the barrel to collect the strained liquid.

Cotton flannel or Canton flannel strainers are cheaper than those of woollen, and if bleached they have the great advantage that they can be used for alkaline solutions. The unbleached cotton flannel is probably stronger, but the coloring matter naturally present, being soluble in alkalies, is apt to discolor the liquid.

Cotton cloth or muslin strainers are generally suspended on a wooden frame, (*tenaculum*) see Fig. 279. The frame should be securely joined without glue, and at each corner there should be a strong, pointed nail projecting slightly outward. The cotton cloth should always be soaked in boiling water before fastening it to the frame, to dissolve out the substances used by the manufacturer in calendering the goods. Fig. 280 shows the method of fastening the strainer to the frame. It should be secured at each corner, first upon the permanent nails, and then two tacks at the side of each nail should be driven two-thirds of their length into the frame ; this partial driving of the nail is sufficient to hold the cloth and permit of the easy removal of the tacks. A strainer hung in this way will hold more liquid and do much better work than one which is tacked all around the frame. This method of straining is particularly useful in collecting precipitates which require washing.

Fig. 280

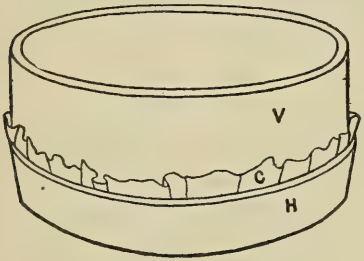


Strainer and frame (tenaculum)

Colation in Smaller Operations.—When solid particles are to be separated from liquids in the operations of the dispensing counter,

several methods may be used. One of the most convenient is to insert a plug of absorbent cotton in the neck of a funnel and then pass the liquid through ; a funnel with a circle of brass wire gauze soldered in it two thirds of the way down is sometimes used, although not recommended, because of the difficulty of cleaning it. A better small strainer is made by using the hard rubber sieve, V, H (see Fig. 281). The muslin gauze, C, is easily replaced, and the sieve may be placed in a funnel. The cotton cloth used by the makers of

FIG. 281



Prescription strainer

FIG. 282

Careless straining

cheese, called cheese cloth, is admirably adapted for many kinds of straining. When coarse muslin strainers are used for the first time, they are prepared by soaking them in hot water and placing them in a funnel carefully so as to line the inside. Care should also be taken to see that the strainer is not too large, for if the wet strainer projects over the edge of the funnel, a syphon action may be set up and more of the liquid delivered outside of the bottle than inside. Fig. 282 shows the action of such a strainer.

QUESTIONS ON SEPARATION OF FLUIDS FROM SOLIDS

What is meant by lotion or displacement washing? (See page 222.)
How may it be effected?
What is a spritz bottle, and what is its use?
What is continuous washing?
How may it be effected?
What is decantation?
What is a guiding-rod, and how is it used?
What is a syphon?
What is the principle of its action?
Where a poisonous, caustic, or disagreeably tasting liquid is to be drawn off by a syphon, how may it conveniently be started?
What is colation?
What materials are used for the purpose?
In what cases are strainers used?
What are felt strainers?
How are woollen strainers used?
What advantages have cotton flannel strainers over those made of wool?
How are muslin strainers used?

CHAPTER XI

FILTRATION

Filtration is the process of separating liquids from solids with the view of obtaining the liquids in a transparent condition. The intervention of porous substances, called *filters*, to intercept the solid particles, is necessary in performing this process. These are usually made from paper, paper pulp, sand, asbestos, ground glass, charcoal, porous stone, etc. The liquid which has passed through the filter is called the *filtrate*.

Paper filters are the most useful of all kinds for the pharmacist, and they are employed in all the finer operations requiring filtration. The solid particles are much more completely separated by filtration through good paper filters than through strainers, owing to the pores of the paper being smaller and more numerous. The paper used for this purpose is especially prepared, and is called *filtering paper*. It is made now upon a large scale, and can be had of excellent quality. Unlike a strainer, it is never used more than once; its cost is so trifling, and it is so easily ruptured when wet, that it is not worth while to attempt to save filters for subsequent use. Filtering paper is found in commerce in two forms,—in large, nearly square sheets, and in circular sheets. The former is used for large filters, and has some advantages, if the waste pieces can be put to use; but it is usually more convenient for the pharmacist to rely for constant use upon the circular sheets of different sizes. The difference in price between the two is now so trifling that the latter is almost always preferred. Two kinds of square sheet filtering paper are commonly found,—German white, a rather thin, but good paper, and heavy French, the latter very thick and porous, having a rough surface; it is the more expensive paper, but is better for special purposes. Of the round filters, the French, Swedish, German, English, and Scotch are among those best known in America. For pharmaceutical purposes the French filters are almost universally used, the "Prat Dumas" brand being the most common, the gray paper being made from a mixture of cotton, flax, wool, etc.; this paper answers sufficiently well for filtering colored liquids, fluidextracts, or tinctures, but, owing to the coloring matter it contains, it should never be used for any solution containing free alkali.

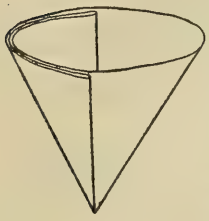
It is safer to form the habit of never using it for liquids that are intended to be colorless when filtered; of course, it is entirely unfitted for analytical work. The "Prat Dumas White" is of good quality, and it or some other good quality of white paper should always be on hand for special purposes, for filtering alkaline or alkaloidal solutions, and for the nicer operations. Very good filtering paper of English and Scotch manufacture may occasionally be procured; that made in Sweden, however, by Munktell, is preferred for the processes of ignition and analytical work; it yields the smallest amount of ash, and

is practically free from soluble salts and impurities. At least a small stock should be kept by pharmacists for especially accurate work.

Methods of folding Filtering Paper.—Two kinds of paper filters are used, the *plain* and the *plaited.*

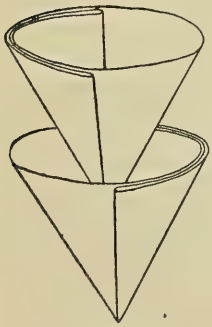
1. *The Plain Filter.*—This filter is used habitually by the analytical chemist, and is preferred by the pharmacist where precipitates are to be collected, and in some other operations (see Fig. 283) ; it is made by exactly doubling a circular sheet of filtering paper upon itself, and then folding this directly in the middle, so that, when opened, four equal divisions or sectors appear ; the filter is used by separating one of the sectors from the other three, and placing the cone formed, into a funnel ; the liquid is then poured upon the filter, and the process of separating the solid from the liquid commences. The advantages of the plain filter are, 1, simplicity and rapidity in folding, no skill being required to make one ; 2, in collecting precipitates, but one-half of the surface of the filter (two sectors) is in contact with the moist precipitate, which is often closely adherent, and therefore but one-half of the surface has to be cleaned. In some cases there may be a disadvantage in the use of the plain filter, owing to the unequal rate of flow,—the tendency of the three folds being to attract the liquid to the side of the funnel upon which they rest, and thus the precipitate may be unequally washed. A stronger and more rapid filter may be made by placing one plain filter inside of another, so that the three sides of the upper one shall be in contact with one side of the lower one, and *vice versa* (see Fig. 284). If the sides of the funnel have an angle of 60°, the plain filter made as described will fit the funnel properly ; but it frequently happens that the angles of funnels vary, and if an ordinary plain filter is placed in a funnel not having an angle of 60°, a portion of the filter is left unsupported, and the

Fig. 283



Plain filter

Fig. 284

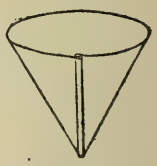


Double plain filter

Fig. 285

Rother's filter (first step)

Fig. 286

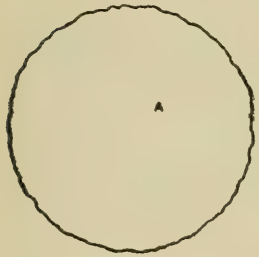


Rother's filter

weight of the liquid is apt to rupture the moist paper. This difficulty may be overcome by making a fresh crease in the outside fold of the plain filter ; if this is made to the right of the original crease of the 60° filter, and the inside fold pushed around a corresponding distance, a filter having a smaller angle is produced, while if the fresh crease is made to the left of the original crease a larger angled filter may be made. Rother's method of making a plain filter has the ad-

vantage of furnishing two filters from the same sheet that is usually required for one filter. To make it, the circular disk of filtering paper is cut through in the line of its diameter, and half of the disk is folded into two equal parts; the double edge of the cut sides is turned down and folded over on itself narrowly several

Fig. 287

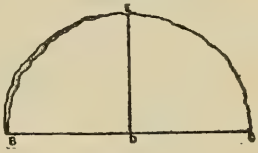


Filter

Fig. 288

Folding plaited filter

Fig. 289

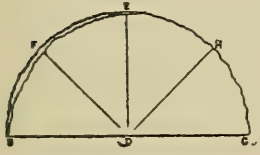


Folding plaited filter

times (see Fig. 285), and with the blade of a spatula the fold is compressed so that it will retain its shape (see Fig. 286). This filter may be used in collecting precipitates.

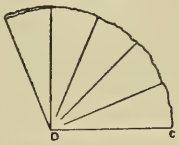
The plaited filter may well be called the "pharmacist's filter," for it is the form almost exclusively used in ordinary filtering operations.

Fig. 290



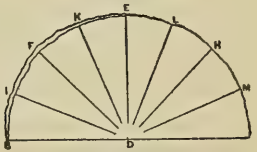
Folding plaited filter

Fig. 291



Folding plaited filter

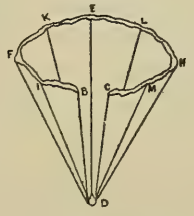
Fig. 292



Folding plaited filter

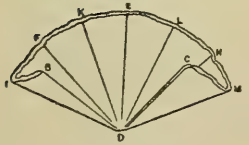
Figs. 287 to 297 show the progressive steps in the folding of a plaited filter. It is made by folding a circular sheet of filtering paper twice, as in making a plain filter.[1] The edge B D, Fig. 290, is then laid upon E D, and the crease F D is formed; in like manner C D is laid upon E D, and H D is formed. Then D B is laid upon F D, and I D

Fig. 294



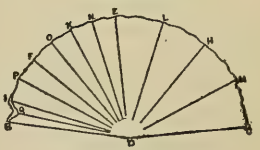
Folding plaited filter

Fig. 293



Folding plaited filter

Fig. 295



Folding plaited filter

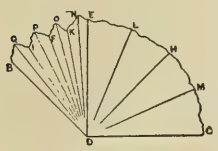
is formed, and by rolling over the fold in the same direction once more until F D is laid upon E D, the crease K D is made (see Fig. 292). Now in the same way C D is laid upon H D and H D

[1] It will be observed that in the first folding of French filters, "Prat Dumas," the disks are not perfect circles. This causes one edge to project (see Fig. 288), and facilitates the opening of the filter.

upon E D, and it will be noticed that the folded semicircle has been creased into eight equal spaces, and that the direction of each crease is the same, so that if the paper is lifted it will appear as shown in Fig. 294.

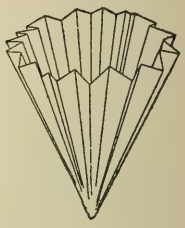
The next step is to fold each one of these spaces *back on itself* (Fig. 295). B D is laid upon F D, and then B D is turned upward and back until it is laid upon I D. This makes the crease Q D, which is the first fold in the opposite direction. Taking both folds between the forefingers and thumbs of both hands, the edges B D and I D are folded upward and back upon F D, and the crease P D is formed; then these three edges, B D, I D, and F D, are taken all together and folded back upon K D, and the crease O D is formed, and so on, each space in turn being folded back in the opposite direction, until the last one is reached.

Fig. 296



Folding plaited filter

Fig. 297

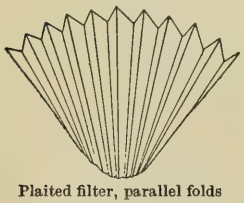


Plaited filter

The folded filter is then held at the apex with the left hand upon a table or flat counter, and pressed and smoothed out with the right hand in order to emphasize the folds. It should then be placed in the funnel, while still *unopened*, to see whether it needs trimming; if the rough edges of the filter project above the top of the funnel, the filter must be removed, and they must be cut off neatly with a sharp knife or a pair of scissors so that the whole of the filter may be placed inside of the funnel. Having satisfied this requirement, the filter should be carefully opened out (see Fig. 297) and placed in the funnel.

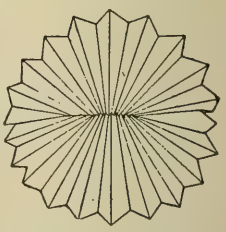
Another method of folding a plaited filter is illustrated in Figs. 298 and 299. A plain filter is folded as in Fig. 283, and the quadrant, consisting of four thicknesses of paper, beginning at the left hand side, is folded at once into narrow parallel plaits backward and forward. Fig. 298 represents the filter after being once opened, and Fig. 299 shows the inside of the filter. It will be observed that the creases do not converge to a point as in the plaited filter (see Fig. 297), and hence the apex is less likely to be weakened.

Fig. 298



Plaited filter, parallel folds

Fig. 299



Plaited filter, parallel folds

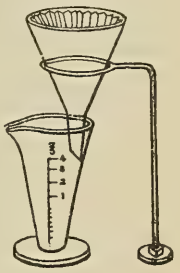
Maxims.—1. In folding a filter, care should be observed not to extend the creases entirely to the apex, but to end them at a distance of about half an inch from it, because the point at which all the creases converge would be thereby so weakened that the weight of the liquid would rupture the filter.

2. The filter should be moistened with water after introducing it into the funnel and before pouring upon it the liquid to be filtered (except, of course, in the case of a liquid immiscible with water).

This promotes rapid filtration, and washes the filter besides. If hot water is available, it is usually to be preferred.

3. If the liquid to be filtered contains free acid or alkali, or if it contains a very fine precipitate, or is very dense or hot, a double filter should be used. In the case of plain filters, they should be arranged as in Fig. 284. If plaited, two sheets of paper should be taken and folded as if they were single. A filter may be also strengthened by placing a small capping filter or plain filter, a piece of well washed linen or muslin folded like a plain filter, or a plug of absorbent cotton, into the funnel before introducing the filter. The apex is always the weakest, the most exposed, and yet the most important part of the filter.

Fig. 300



Arrangement of funnel in filtration

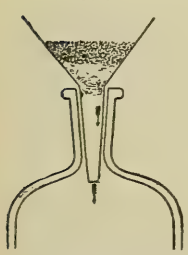
4. In pouring the liquid into the filter, the stream should never be delivered directly upon the apex, but upon one of the sides, so that the force of the fall will be broken before the weakest point is reached.

5. The filter should be entirely within the funnel. If the edges of the paper project above the funnel, waste from evaporation in volatile liquids, also from the increased and unnecessary absorption due to the excess of filtering paper, ensues, and in addition an untidy and careless habit is encouraged.

6. The end of the funnel should touch the side of the receiving vessel, so that the filtrate will trickle down its inside edge. By this expedient splashing will be avoided (see Fig. 300).

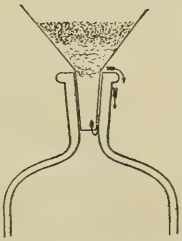
7. In filtering into a bottle, care should be observed to leave sufficient space between the neck of the funnel and the mouth of the bottle for the escape of air, otherwise filtration will be retarded or prevented; a piece of twine placed between the two surfaces generally serves a good purpose. *The end of the funnel should project below the lowest part of the neck of the bottle* (see Fig. 301). If the diameter of the end of the funnel is too large to admit of this, or if it is only half inserted, the filtrate will be very apt to fill the intervening space and flow over the outside of the bottle, as shown by the arrows in Fig. 302.

Fig. 301



Filtering into a bottle (proper method)

Fig. 302

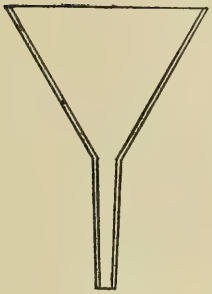


Filtering into a bottle (improper method)

Funnels, sometimes called *tunnels*, are conical shaped instruments intended to facilitate the pouring of liquids into narrow mouthed vessels, and, as they have also an important service to perform for the pharmacist in supporting filters, they will be considered in this place. Funnels are made of tinned copper, tinned iron, hard rubber, Berlinware, porcelain, queensware, granite or agateware, earthenware, or glass. Metallic funnels have an advantage in point of durability over porcelain and glass, but a disadvantage in being acted upon chemically by liquids and in being more difficult to clean. The

triangle formed by the sides of a funnel, and the line joining them, should be equilateral (see Fig. 303). The angles being each 60°, a funnel having this shape will accurately support a plain filter made in the usual way. Funnels are frequently fluted, grooved, or ribbed on the inside for the purpose of facilitating the downward flow of the filtrate (see Fig. 304), or wire frames, either fixed or folding, are arranged in a plain funnel with the same object. These aids are of doubtful utility, however, while the tendency of the raised ribs is to form a lodgement for foreign substances. *A well made plaited filter* in a plain funnel will perform as much work in the same time, and if the habit is once formed of always carefully and skilfully folding a

FIG. 303



Plain funnel

FIG. 304

Ribbed funnel

FIG. 305

Tinned copper funnel

filter, its importance in saving time and labor will be appreciated ever afterwards. One of the ribbed funnels in the market has an improvement in the neck, which, instead of being round, is triangular. This permits the free escape of air from the interior of the bottle, and is much superior to the indistinct groove which is often made on the outside surface of porcelain funnels. Plain glass funnels are more generally useful to the pharmacist than any other kind. They are easily cleaned, and dirt upon them may be quickly seen. They are very useful as percolators, and the whole process of filtration or percolation may be observed without trouble. Their only disadvantage is the ease with which they are fractured. The next kind in point of usefulness is the plain tinned copper funnel. The neck should be grooved, square or triangular, instead of round. Copper funnels are far superior to those made from tinned iron, and the difference in cost is greatly in favor of tinned copper, if true economy is considered (see Fig. 305). Hard rubber funnels are light in weight, and are not very easily broken, for they may be often dropped upon the floor without injury (see Fig. 306). They are not acted upon by chemical substances, and with ordinary care will last a lifetime. They lack one advantage of those made from glass, however, in their absence of transparency. A hard rubber funnel divided, to hold a strainer, may be used at the dispensing counter (see Fig. 307). Porcelain, queensware, or Berlinware funnels are, of course, not transparent, and they have the disadvantage, at least in the larger sizes,

of being heavy. They are, however, not affected by liquids, but their advantages over glass are so slight (being somewhat less fragile) that they are not often employed. Earthenware funnels, if well glazed, are very useful in filtering *hot liquids*. Enamelled funnels, called granite or agateware, etc., are made from sheet iron having the surface entirely covered with a glazed composition which resists the action of most chemical substances. If carefully used, they answer for many purposes. Their greatest objection arises from the brittleness of the enamel, which is apt to chip off if the funnel is dropped upon the floor or subjected to a blow, and at the point where the neck of the funnel is joined to the body, the enamel coating is so thin that by constant use and knocking about it is soon chipped off, the exposed iron quickly rusts, and the neck breaks off from the body. Tinned iron funnels are most largely used, and are popular because of their cheapness; but it is quite possible for a pharmacist to ruin in one operation a preparation worth ten times the cost of the funnel by filtering it through a tinned iron funnel and allowing it to come

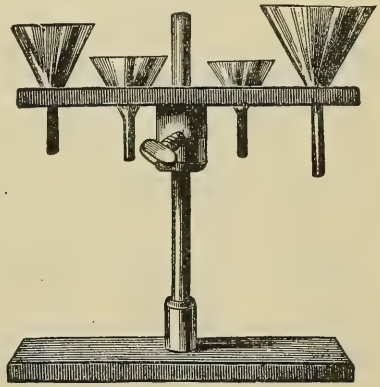
Fig. 306

Hard rubber funnel

Fig. 307

Dispensing counter funnel

Fig. 308



Funnel stand

in contact with the iron exposed by the wearing off of the tinned surface.

Fig. 308 shows a funnel stand useful for small filtering operations in the laboratory or at the prescription counter.

Fig. 309 shows Bartlett's funnel, which has a perforated sleeve around the spout to permit the escape of air from the bottle in which it is placed, when the liquid is running through the funnel.

Fig. 310 shows a funnel designed for filling bottles, in which the flow of the liquid is controlled by the valve operated by the thumb. This is convenient when filling a gross of bottles arranged in rows, and if carefully used the bottles need not be soiled on the outside through overrunning, and the quantity in each bottle can be nicely adjusted.

Filters for Special Purposes.—In the course of laboratory work it frequently happens that large quantities of liquids require filtering, and the methods suitable for smaller operations cannot be profitably employed. The filtration and purification of water often become necessary. Charcoal in some form is frequently employed, not only on account of its porous character, but also because of its power of absorbing odors and depriving liquids of color. Sand, powdered glass, or asbestos forms an excellent filtering bed. A very practical

and inexpensive charcoal filter is shown in Figs. 312 and 313. It was devised by Dr. Hadden, and is illustrative of a principle in filtration not heretofore treated of in this work,—*i.e.*, *upward filtration.* It is believed by the advocates of upward filtration that great economy

Fig. 309

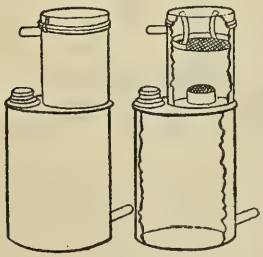
Bartlett's funnel

Fig. 310

Valve funnel

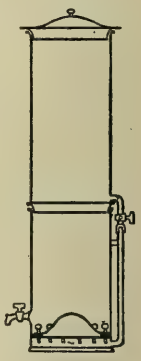
is secured by passing the cloudy liquid upward through a filtering bed, the principle of action being that impurities settle away from the filtering medium by force of gravity, instead of accumulating upon it and clogging the pores. Figs. 312 and 313 show an external and a dissected view of the filter. A gallon tin can has a short pipe soldered to it near the bottom; the pipe has a piece of perforated tin or gauze soldered over the opening into the can, to keep it from being filled up. This can is filled with clean gravel. The smaller quart can is connected with the lower one by a raised perforated tin diaphragm, and small pieces of charcoal are packed upon the diaphragm; the upper perforated diaphragm is movable, and is intended to keep the charcoal in place. A disk of coarse cotton flannel should be placed on top of the charcoal, to keep the fine charcoal dust from working through the top to the upper tin can. This is kept in place by a screw joint and washer such as is often seen on fruit cans. About an inch from the top of the can is a small piece of pipe for delivering the filtered water. This filter is, of course, intended to be used in cities and towns, or where water is supplied under pressure. Both the supply and the exit pipe should be of proper diameter to permit the use of a rubber tube for connecting with the water supply and delivering the filtered water. The filtration of oils is often effected in a similar manner, one of the earliest applications of this principle being the oil filter or strainer of Wm. R. Warner, of Philadelphia (see Fig.

Fig. 312 Fig. 313



Hadden's filter — Hadden's filter (interior)

Fig. 314



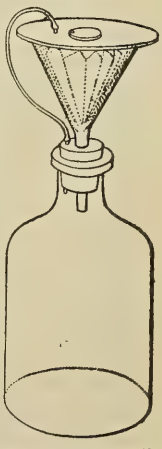
Warner's filter

314). This filter or strainer consists of an upper cylindrical tinned iron vessel, about twenty-two inches high and ten inches in diameter, with a flange rim soldered on the bottom, of rather less diameter, and about an inch wide, so as to fit firmly into the open top of another cylindrical tin vessel of the same diameter and eighteen inches high. The upper vessel is furnished with a lid, and with a tube and stopcock; this tube penetrates the side close to the bottom, and fits into another tube, which opens into the lower vessel close to its bottom and is secured to the side by a strong tubular stay. The filtering medium is a cone of hat felt projecting upward from near the bottom of the lower vessel, and secured by thumb screws passing through two tinned iron rings and the felt, which are all properly pierced for the purpose. The stopcock being closed, the upper vessel is fitted in its place, and the tube joint rendered tight by wrapping twice around it a strip of isinglass plaster well moistened. When this is dry, the upper vessel is filled with the crude oil and the stopcock opened, that the oil may flow into the open space below the filter. A heat of 120° F. is preferred to facilitate filtration or colation, and the filtered oil, as it accumulates, should be drawn off, as any large amount greatly retards the process by decreasing the force of the column bearing on the filter. For a pressure filter or strainer, Prof. B. S. Proctor uses a quadrangular cloth filter bag securely tied to the end of a tin tube five feet long. The extremity of the tube has a wire ring soldered to it, to keep the bag from slipping off.

Continuous Filtration.—Most of the expedients used in continuous washing (see page 223) are applicable to continuous filtration.

Filtration of Volatile Liquids.—It is evident that the ordinary methods of filtering liquids will not be practicable for very volatile liquids, because of the loss through evaporation, and the liability to explosion, in the case of inflammable volatile liquids, if brought in contact with flame. Funnels must be covered, and provision made for the escape of the confined air in the receiving vessel. The following method is preferred to the elaborate expedients usually recommended. A glass tube (one of those usually sold as julep tubes answers very well) is arranged in a glass or metallic funnel, so that the tube will lie close to the side of the funnel and allow one end to project above the filter, but not above the edge of the funnel. It may be held in its place by a ring of absorbent cotton gently thrust into the throat of the funnel. Or a rubber cover perforated to admit a tube is placed on top, and connection between the bottle and funnel effected as shown in Fig. 315. For larger operations, Dr. Hadden's water filter or Warner's oil filter (see pages 235 and 236), slightly modified to suit the liquid, might be used. A very neat method of filtering volatile liquids is provided in the apparatus contrived by E. H. Hance, of Philadelphia. This consists of a cylindrical vessel, provided with a tubulure and stopcock below, and a ground glass cover above; a flange near the top affords support for a perforated filter support or funnel containing a filter.

Fig. 315

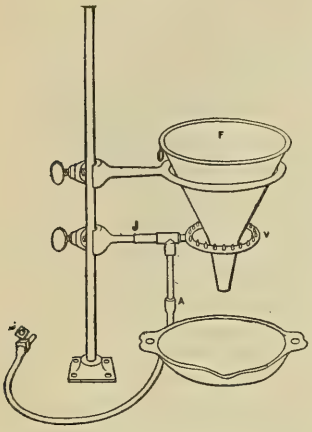


Filtration of volatile liquids

When not needed for filtration, the receiving vessel is very useful for many other purposes.

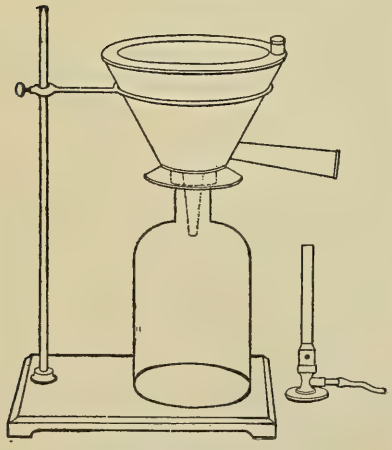
Hot Filtration.—This process is not resorted to as frequently as it might be with advantage, because of the difficulties which are asserted to attend it. These have been greatly overestimated, for by the use of simple, properly contrived apparatus many preparations which heretofore have been dispensed, bearing an unsightly cloudy appearance, can be greatly improved. Yellow wax is frequently full of mechanical impurities; ordinary straining will not deprive it of these, but it may be filtered through paper and thoroughly purified. Jellies, benzoinated lard, petrolatum, cerates, ointments, etc., may thus be filtered. One of the simplest and most easily managed forms of apparatus (see Fig. 316) is made by filing off the ring from one of the ring supports of a retort stand, J, and slipping on to the arm a brass circular jet, V, attached to a tee carrying the gas supply pipe, A. A tinned copper or tinned iron funnel is supported by an appropriate ring at a suitable distance above the jet. The filter is placed in the funnel, a receiving vessel adjusted below, and the hot liquid poured into the filter. It is plain that the liquid can be heated to almost any degree, and the filtration conducted at a much higher temperature (if need be) than by the jacketed hot water funnel (see Fig. 317), and, on the other hand, the heat may be regulated so that it will be very moderate. The hot water funnel is an old device, and consists simply of a jacketed funnel having a wide tube soldered at the lowest point, and an opening in the upper edge for the water supply. A burner or lamp flame will heat the water contained between the funnels, and a regulated heat not exceeding that of boiling water is obtained (see Fig. 317).

Fig. 316



Hot filtration

Fig. 317



Jacketed hot water funnel

Fig. 318

Hot filtration (use of coil)

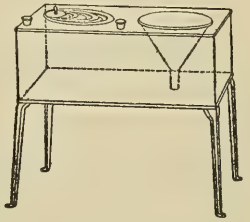
Fig. 318 shows another form of funnel to be used for hot filtration, the coil of pipe may be used for steam or hot water, by connecting it with a suitable supply.

A modification of Dr. Hare's hot water filter, which permits the use of glass funnels of different sizes, is shown in Fig. 319. It is simply a tinned copper box, with two sides shaped like a trapezoid, and supported upon four legs. There are three one-inch tubulures in the bottom, and the top has three openings which centre with the tubulures; beginning with the deepest, the diameters are four, three, and two inches. Three glass funnels of different sizes are selected, and the corks for the tubulures in the bottom, having been chosen, are perforated so as to permit the necks of the funnels to pass through and form perfectly tight joints. Water is placed in the box and heated by the burner, as shown in the cut. When not needed for hot filtration, solid corks may be used to close the tubulures, and the box used as a water bath, covers being placed over the openings which are not in use. Fig. 320 shows a combined water bath and hot water filter.

Fig 319

Hot filtration

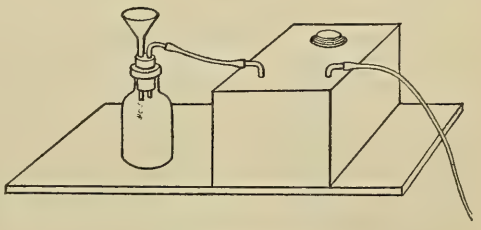
Fig. 320



Hot filtration (water bath)

Rapid Filtering Apparatus.—Of late years much attention has been given to methods for increasing the rapidity of filtration. Most of the plans suggested depend upon the principle of filtering into a partial vacuum, but the means used to obtain this vacuous space are very varied. A simple method, applicable to operations on the small scale, consists in fitting a good cork to a wide mouthed bottle and perforating it so that the neck of a funnel will accurately pass through it; another perforation permits the insertion of a piece of glass tube of small diameter. A plain filter of well washed coarse linen or muslin cloth is then carefully adjusted in the funnel, and a plain filter of paper placed upon it. The liquid is poured upon the filter, and, a rubber tube having been fitted to the glass tube, suction is applied by the mouth. By pinching the rubber tube a partial vacuum is maintained in the bottle, and filtration is hastened. An improvement upon this would be to use a rubber stopper instead of cork, and instead of pinching the rubber tube to use a screw pinchcock.

Fig. 321



Rapid filtration

Water Pumps acting by a Fall of Water.—One of the first prac-

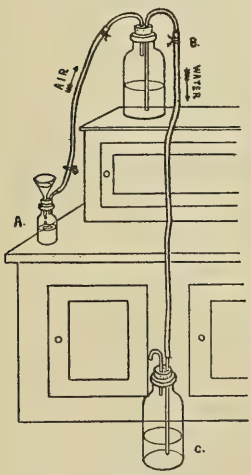
tical efforts made in the direction of using water power was seen in Bunsen's pump. The action depends upon the principle that a column of water descending through a tube from a height is capable of sucking with it the air contained in a lateral tube, if the latter is properly arranged. A cheap home made apparatus, which depends upon a fall of water for its usefulness, is shown in Fig. 321. It consists of a common wide mouthed half-gallon jar, and a tinned iron can holding three, four, or five gallons; a castor oil can answers very well. The screw cap is for readily filling the can; the exhaust pipe on the right reaches inside of the can, nearly to the bottom, the other tube is soldered on the head of the can connecting with the interior. The jar, having a funnel fitting into it through an airtight stopper, is connected with the can by means of a bent glass tube and rubber tube. The can is filled with water, and the solution to be filtered is placed in the funnel. The exhaust pipe is connected with a rubber tube eight or ten feet long and a quarter of an inch in diameter (the longer the tube the more rapid is the filtration). When the syphon thus formed is started, the flow of the water from the can carries with it the air from the bottle.

Fig. 322

Lux's aspirator

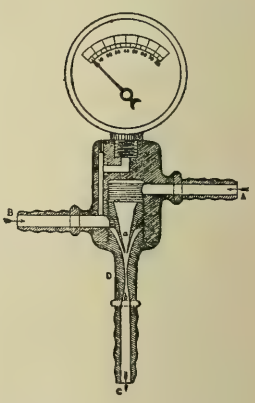
Lux's aspirator (see Fig. 322) is constructed by fitting two accurately perforated rubber stoppers to the ends of a piece of wide glass tubing; four short glass tubes are inserted in the stoppers, as shown in the cut. One of the tubes is for the supply of water, another carries it off, the third tube is connected with the vessel to be exhausted, while the fourth tube may be put to the same use, or connected with a vacuum gauge or closed with a stopper. If the air is to be aspirated by one of the lower tubes, the vessel to be exhausted must stand on a higher level than the aspirator. The length of the exit tube determines the power of the aspirator. It should have a bore of one-fifth of an inch and be at least ten feet long, and it should be provided with a screw pinchcock to regulate the flow of water. A very simple apparatus is shown in Fig. 323. A very moderate fall of water is needed here. It is, however, adapted only to small operations. Two rather large bottles, of equal capacity, are selected; these are connected by rubber tubing as shown in the illustration. Into the neck of each a tightly fitting stopper is adjusted carrying a glass tube. A bottle, provided with a tightly fitting stopper carrying a small bent tube and a funnel, is attached to a rubber tube provided with a con-

Fig. 323



Rapid filtration

Fig. 324

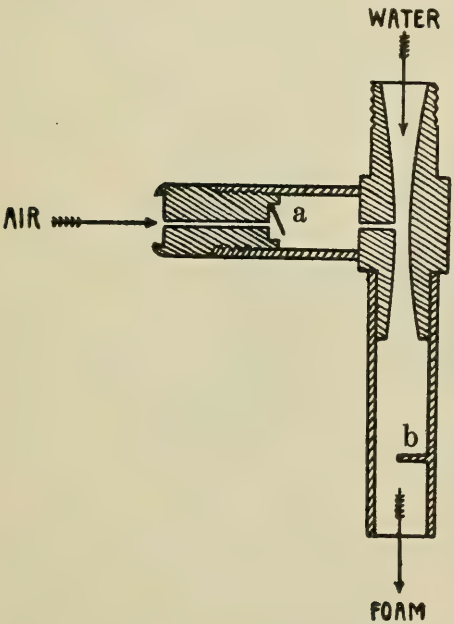


Fisher's vacuum pump

veniently situated pinchcock. One of the large bottles is filled with water and placed on an elevated shelf, when the water will flow down to the other bottle. And if the connections are made as shown in the cut, it will aspirate through the funnel; and if the funnel is full of liquid, it will cause the latter to run through quite rapidly. When the lower bottle is full, it is substituted for the upper one, and the connection with the vessel to be exhausted, transferred to it.

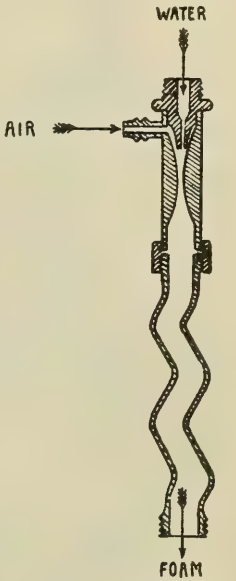
Water Pumps acting by Pressure.—It is usually inconvenient to operate aspirators which depend upon a fall of water through a long tube, except in high buildings. Hence, water pumps which are oper-

Fig. 325



Chapman's pump

Fig. 325a

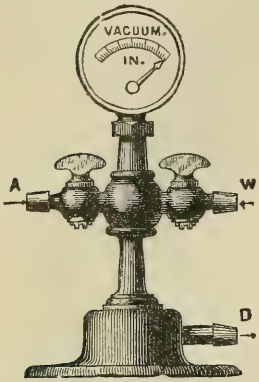


Richards's pump

ated by pressure are generally preferred in cities and towns, or in localities where water is supplied under pressure. The following are selected from the great variety in use as being good illustrations of the principle. Those made of glass are not recommended, because of their extreme liability to breakage. Fisher's vacuum pump is well shown in Fig. 324. A, B, C, are intended to receive rubber tubing, and the neck, D, may be fastened by a clamp to a retort stand or other upright fixture. Water from the hydrant enters at A, passes through the nipple at *a*, and, being forced through the contracted portion, *b*, draws with it the air from the tube, B, which is attached to the filter. A communication is also made with the vacuum gauge, as shown in the cut, to mark the degree of exhaustion. Fig. 325 shows another modification of a vacuum pump. The valve at a pre-

vents the water from flowing into the bottle which carries the filter when the pressure of water ceases or is reduced. Fig. 325a illustrates a form of pump largely used in analytical laboratories for hastening filtration. The zigzag form of the tube serves the same purpose as the projection in the lower portion of the outlet tube of the Chapman pump,—*i. e.*, to break the direction of the solid stream of flowing water and assist in drawing the air from the bottle. Schutté and Goehring, of Philadelphia, have contrived an apparatus which is somewhat more convenient from their having placed it upon a base and deflected the lower tube laterally. This permits the use of the apparatus in many places where Fisher's pump could not be used. It is shown in Fig. 326. W represents the water supply tube, D the outlet, and A the aspirating tube.

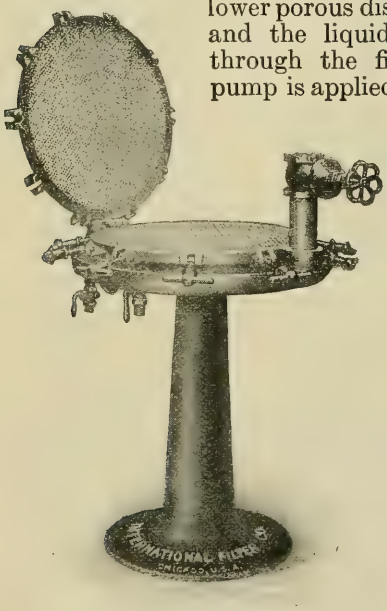
Fig. 326



Vacuum pump

Filtration under Pressure.—Fig. 327 illustrates a form of laboratory filter for use when a large quantity of the same liquid is to be filtered. It is made by the International Filter Co. of Chicago. A sheet of filter paper is placed between the upper and lower porous disks, which are then clamped together, and the liquid to be filtered is forced upward, through the filter. Pressure from gravity or a pump is applied to increase the rapidity of filtration.

Fig. 327



International disk filter.

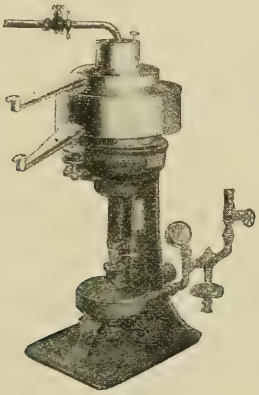
Centrifugal Filtration.—Figure 327a illustrates the De Laval Centrifugal Filter, made by the De Laval Separator Co.

Fig. 327b gives a sectional view of the clarifier and filter bowl and shows that part of the machine in which the clarifying and filtering are actually accomplished. This consists of two separate compartments, the work performed therein being entirely dissimilar, really that of two independent machines.

The first or lower section is the clarifying compartment, the upper the filtering chamber. The clarifying compartment consists of a cylinder filled with a series of conical shaped, pressed steel disks, one above the other, about one thirty-second of an inch apart, and held rigidly in position by a central feeding device. The filtering chamber or upper section is also cylindrical in shape, but of less diameter than the clarifying compartment.

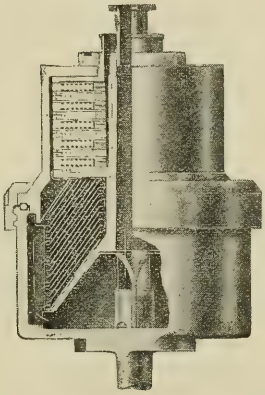
The liquid first enters the bowl through the feeding device in the center and drops to the bottom of the clarifying compartment, just below the conical disks, where much sediment is retained. It is then forced outwards by centrifugal force, through openings at the bottom, to the compartment on the outer circumference of the clarifying chamber, where the bulk of heavier sediment is deposited. The liquid is next drawn to the center between the several disks. The purpose of these conical disks is to divide the liquid into thin layers; thus the friction on the disks above and below causes it to revolve rapidly, and the heavier part, or balance of the sediment, is gradually forced to the under side of the disk above, thence down and out, while the thoroughly clarified liquid passes to the center and is forced upwards into the second or filtering chamber. When the liquid

FIG. 327a



Centrifugal filter

FIG. 327b



Centrifugal filter, interior

enters this compartment fully 98 per cent. of the sediment and foreign matter has been removed, thus leaving a small though very important work for the filter to accomplish.

The filter chamber is filled with a series of horizontal corrugated plates and perforated retaining rings, between which are placed one or more thicknesses of filter material, paper, felt, cloth, or whatever may be best adapted to the work in hand. The liquid is forced upward into the narrow space between the periphery of the filtering chamber and the filtering disks. This allows a channel for the liquid to pass through, from which it is forced through the filtering material. Here it is again forced to the center and upwards to the discharge point.

QUESTIONS ON FILTRATION

What is filtration? (See page 229.)
Of what are filters usually made?
What is the liquid that passes through a filter called?
What kind of filters are most useful and most largely employed?
What objection is there to the ordinary gray filtering-paper that is commonly used?
What is the difference between a plain and a plaited filter?
How is a plain filter folded?
What is its special advantage?
What is a disadvantage of a plain filter, and how may such disadvantage be obviated?
What is Rother's method of making a plain filter?
What advantage has this?
How is a plaited filter ordinarily made?
How can a plaited filter be folded differently, so as to strengthen its apex?
In folding a filter should the creases extend entirely to the apex? Why?
What exceptions are there to this plan?
What are the advantages of moistening a filter before filtration?
In what cases should a double filter be used?
How may a paper filter be strengthened?
How should the liquid be poured into a filter?
Should a filter extend beyond the edges of the funnel? Why?
In filtering into a bottle what precautions must be observed?
For what are funnels used?
Of what materials are they usually made?
What angle should a funnel have?
What kind of funnel is most generally useful?
What are the advantages of a ribbed funnel? Of those having the outside of the neck triangular?
What is the advantage of tinned copper for funnels? Of hard rubber? Of porcelain?
For what purposes are earthenware funnels useful?
What is an objection to enamelled (called granite- or agate-ware) funnels.
What is an objection to tin funnels?
What are the advantages of a hard-rubber funnel?
Describe the construction of a funnel used for filling bottles.
How is upward filtration performed?
Describe Hadden's filter.
Describe William R. Warner's oil-filter.
How may continuous filtration be accomplished?
How may volatile liquids be filtered?
How may hot filtration be accomplished?
What is a jacketed funnel?
How may a coil of pipe be used to effect hot filtration?
Describe Dr. Hare's hot-water filter.
How may the rapidity of filtration be increased?
How may a fall of water be made to increase the rapidity of filtration?
Describe Lux's aspirator.
Describe Fisher's vacuum pump.
Describe Chapman's vacuum pump.
Describe Richard's vacuum pump.
What are the advantages of the vacuum pump made by Schutté and Goehring?
Describe a pressure filter. What are its advantages and under what conditions can it be used?
Describe the De Laval centrifugal filter.

CHAPTER XII

CLARIFICATION AND DECOLORATION

Clarification is the process of separating from liquids, without the use of filters or strainers, solid substances which interfere with their transparency. The processes of clarification and decoloration from a pharmaceutical point of view have declined in importance of late years, owing to the fact that chemical and other substances requiring the processes are supplied in a purified condition so cheaply that it is absolutely impossible for the pharmacist to compete with the manufacturer who operates on the large scale and uses apparatus and methods which are thorough and economical. This is particularly the case with sugar and the alkaloids. Formerly the apothecary bought raw sugar and clarified the syrup ; now the difference in price between raw sugar and that which is pure is so slight that no one ever makes syrup from raw sugar. The decoloration of alkaloidal solutions and the manufacture of alkaloids cannot be economically attempted on the small scale by the pharmacist, because of the want of continuity of the process; the manufacturer, on the other hand, can use the animal charcoal repeatedly until its power is exhausted, and in other ways practise economy not possible to the apothecary. It is, nevertheless, very important to comprehend thoroughly the principles underlying both processes.

Clarification may be effected in several ways :

1. By the application of heat. 2. By increasing the fluidity of the liquid. 3. Through the use of albumin. 4. Through the use of gelatin. 5. Through the use of milk. 6. Through the use of paper pulp. 7. By fermentation. 8. By subsidence through long standing.

1. *By the Application of Heat.*—When a viscid liquid is heated, its specific gravity is diminished, and frequently particles which were suspended in it, and interfered with the transparency of the liquid, will separate, the heavier ones falling to the bottom, and the lighter ones rising ; in the latter case, ebullition facilitates the separation, the minute bubbles of steam becoming enveloped in the viscid particles rise through their buoyancy, and a scum is formed which may be readily separated. The official process for the clarification of honey (Mel Depuratum) is a good illustration of the use of heat in this connection.

2. *By increasing the Fluidity of the Liquid.*—Clarification by this method depends upon decreasing the specific gravity of the liquid by the addition of water, alcohol, or other liquid lighter specifically than the one to which it is added ; this causes the suspended particles to subside, and the clear liquid may then be decanted.

3. *The Use of Albumin.*—The property possessed by albumin of remaining liquid at ordinary temperatures and becoming coagulated by heat renders it one of the most useful substances that can be em-

ployed in the process of clarification. Its action is mechanical, and where albumin exists naturally in the liquid, as in many fruit and vegetable juices, the simple heating of the liquid suffices to coagulate the albumin, which envelops the particles that render the liquid cloudy, and these rise to the top and are skimmed off. Albumin, or white of egg, is frequently added to liquids to clarify them ; in such cases it should always be added before the liquid is heated. This is best accomplished by adding about an equal bulk of the liquid to the albumin, then introducing the mixture into a muslin strainer and squeezing it through the meshes of the cloth by gathering up the corners and spirally twisting the strainer, when the organization of the albumin is destroyed, and a smooth mixture results ; the strained solution is then added to the liquid to be clarified, and the whole heated gradually (usually until it boils), without stirring, until coagulation is effected. In most cases the white of one egg is sufficient for a gallon of liquid. The error most frequently made by operators is the use of an excess of albumin. Care must be taken not to use albumin as a clarifying agent in those cases where the active principle of a liquid forms a precipitate by combining with it.

4. *The Use of Gelatin.*—Gelatin is used when tannin is present and is the cause of cloudiness, or when it is desirable for other reasons to remove it. Its action depends upon the fact that gelatin forms with tannin an insoluble compound ; this is, indeed, the basis of leather. Isinglass, one of the purest kinds of gelatin, is the preferred form ; it is frequently employed for clarifying infusions containing tannin, such as tea and coffee, etc. It is used by adding a weak solution of the gelatin in hot water to the liquid before it is heated, and allowing the liquid to cool. The insoluble compound formed must always be strained or filtered out.

5. *The Use of Milk.*—The presence of casein in milk, and the fact that acids precipitate it in the form of a curdy precipitate, are taken advantage of in the use of milk as a clarifying agent. It is employed particularly for vinous preparations, sour wines, etc., and should not be used in excess.

6. *The use of paper pulp* does not depend upon chemical combination, its action being purely mechanical. Paper pulp for filtering is best prepared by placing filtering paper (the saved trimmings and scraps left from making filters answer well) into a mortar or other vessel, and pouring enough solution of sodium or potassium hydroxide on it to saturate it, then stirring it with the pestle until it is reduced to a pulp. This should then be washed by placing a loose plug of absorbent cotton in a funnel and pouring in the mixture. When it has drained, hot water should be poured upon it until all traces of alkalinity are washed out ; the dried purified pulp may then be placed in stoppered wide mouthed bottles until needed. It is used as a clarifying agent by adding a portion to the cloudy liquid, agitating the mixture, and allowing the whole to stand quietly until the liquid is clear ; or, as a filtering agent, after the addition of the pulp, the mixture may be thrown upon a wetted muslin strainer, and if the liquid which passes through at first is not clear, it may be returned until it becomes so. It will be found that particles of pulp will partially fill up the meshes of the strainer, and an excellent filtering bed is

thus formed. Care should be taken, therefore, not to stir up the mixture after it is placed on the strainer.

7. *By Fermentation.*—The changes in the composition of juices after they have been fermented usually lead to the deposition of those substances which previously interfered with the transparency of the juices; the generation of alcohol through fermentation produces a liquid in which the substances are insoluble, hence the formation of a deposit. The preparation of syrup of raspberry affords a good illustration of the principle of clarifying juices by fermentation, while in the manufacture of wines the principle has been known and practised for centuries. (See Fruit Juices, Chapter LIV.)

8. *By Subsidence through Long Standing.*—This method involves the least possible amount of labor and expense, and it is resorted to very frequently (particularly upon the large scale) when haste is unnecessary, and whenever the liquid keeps well enough to withstand the tendency to spoil during the time necessary to effect complete separation. The deposit formed is called a *sediment.* This term is not synonymous with *precipitate. Sediment is solid matter separated merely by the action of gravity from a liquid in which it has been suspended. A precipitate, on the other hand, is solid matter separated from a solution by heat, light, or chemical action.* The fixed oils are clarified by subsidence; in the vegetable oils the sediment consists principally of albuminous and gummy substances which have been separated with the oil during the process of expression.

Decoloration is *the process of depriving liquids or solids in solution of color by the use of animal charcoal.* Decoloration is used in the abstraction of coloring matter from fatty bodies, oils, petrolatum, syrups, honey, etc. Animal charcoal, or bone black, which is produced by heating bones in close vessels out of contact with air, and then grinding them, is generally preferred in decolorizing operations. Wood charcoal possesses but little power in this direction. It has been generally settled that the decolorizing property is owing to the formation of insoluble compounds of the coloring matter when it is brought in contact with porous charcoal. Animal charcoal varies greatly in its power. The official purified animal charcoal is often not so powerful as a decolorizer as the animal charcoal from which it was made; but bones contain calcium phosphate and calcium carbonate, and the object of the purifying process is to separate these salts, because, in many of the delicate operations of pharmacy, particularly the decoloration of vegetable acid solutions, these salts would be dissolved by the acids, and the solutions thus contaminated. The most powerful animal charcoal is produced by calcining dried blood and other animal matter with pearlash, and afterwards washing out the pearlash with water, and subsequently with an acid solution. The charcoal need not be dried before using. For other information about the properties of charcoal, see *Carbo Animalis* and *Carbo Animalis Purificatus*, U. S. Dispensatory, 18th edition, page 326. For most decolorizing operations of the pharmacist on the small scale, the solutions, melted fats, oils, etc., can be introduced directly upon the animal charcoal, which is placed in a funnel and prevented from falling through by the insertion of a plug of absorbent cotton, or it may be arranged in an ordinary percolator, and the cold liquid percolated

through the charcoal, or the liquid simply agitated with the charcoal and the mixture filtered. It is very important to remember that charcoal absorbs a number of valuable principles used in medicine,—*e.g.*, *bitter substances*, like gentiopicrin, aloin; *astringents*, like tannin; *alkaloids*, like quinine, morphine, strychnine, cocaine, etc. Charcoal has even been used as an antidote for poisoning with the alkaloids. It should always be used, in decoloration, with discrimination and judgment, or it may be found that in striving to improve the appearance of a preparation by lessening the color its value has been sacrificed. John Uri Lloyd has demonstrated that aluminum silicates in the form of kaolin, Fuller's earth, or specially prepared hydrous aluminum silicate, when shaken with solutions of alkaloids, completely remove the alkaloids. These substances should therefore never be used as filtering or clarifying agents for alkaloidal preparations and in fact, this action of aluminum silicate has now been applied to the commercial separation and preparation of alkaloids. Attention should also be called to the action of ferric hydroxide upon solutions of pepsin and other digestive ferments combined in elixirs or other preparations, with cinchona, gentian, etc., the ferric hydroxide being used as a detannating agent. Under these conditions the digestive ferment is destroyed or completely removed with the precipitate.

QUESTIONS ON CLARIFICATION AND DECOLORATION

What is clarification? (See page 245.)
In what various ways may it be effected?
How is it effected by the application of heat?
How is it effected by increasing the fluidity of the liquid?
How does albumin act in clarifying liquids?
When is gelatin useful in clarifying liquids?
How does milk act in clarifying liquids?
What is the action of paper pulp in clarifying liquids?
How does fermentation act in clarifying liquids?
What is the difference between a sediment and a precipitate?
What is decoloration, and for what articles is it used?
What substance is generally preferred in decolorizing operations?
How is the most powerful animal charcoal produced?
What valuable principles used in medicine does charcoal absorb?
For what class of substances has charcoal been used as an antidote?

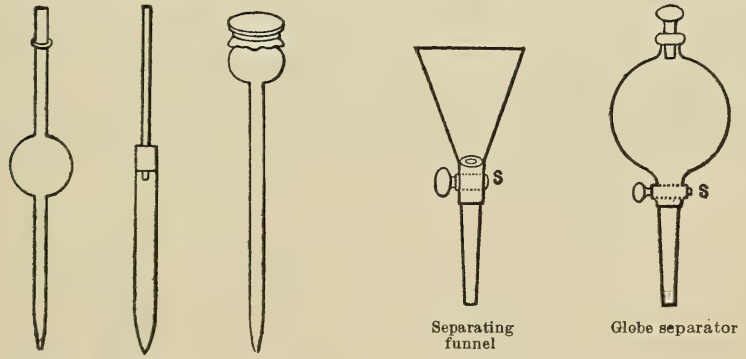
CHAPTER XIII

SEPARATION OF IMMISCIBLE LIQUIDS

THE separation of liquids which are mutually soluble is usually effected by distillation, if one or both of the liquids are volatile (see page 160); but the separation of liquids which do not mix with each other is generally a simpler process, and the object of this chapter is to show the methods at present in use.

Use of the Pipette.—This simple instrument consists of a narrow tube with its lower end drawn out to a capillary orifice, and a bulb, either globular or elongated, blown in it near the top; the upper edge is usually surrounded by a smooth glass ring to strengthen it. It is used by dipping the lower orifice into the liquid that is to be separated and applying suction with the mouth at the upper end; the liquid rises, fills the bulb, and, if the end of the moistened forefinger is applied to the top, the liquid may be carried some distance without running out. Fig. 328 shows the ordinary form of the instrument. Fig. 329 can be readily made from a glass syringe tube, a perforated cork, and a piece of tube, by one unskilled in glass blowing. Fig. 330 shows a pipette which has a piece of sheet rubber tied over the thistle shaped top. If pressure is applied to the rubber, the air is partially expelled; if the point of the pipette is then applied to the liquid and the pressure relaxed, the liquid will rise, and it may be transferred

FIG. 328 FIG. 329 FIG. 330 FIG. 331 FIG. 332



Plain pipette — Syringe pipette — Pipette (sheet rubber top) — Separating funnel — Globe separator

to another vessel. A modification of this, where a rubber bulb is attached to the pipette and used in a similar manner, is seen in Fig. 42.

Use of the Glass Syringe.—The glass ear syringe, having a bulb blown near the orifice, is very useful in collecting a small quantity of

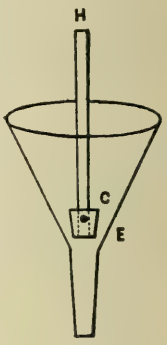
oil floating on top of a liquid contained in a beaker or open vessel. The piston of the syringe should be well soaked in warm water before attempting this simple but delicate operation.

Use of the Separating Funnel.—This instrument, as indicated by its name, is used to facilitate the separation of immiscible liquids. It is generally a funnel having a glass stopcock in its neck (see Fig. 331). The mixed liquid is poured into the funnel, which is placed in position where it can come to rest, and the lower liquid is then allowed to run off by opening the stopcock. With careful use, liquids can be separated with great accuracy in this way. Where the liquid is valuable or very volatile, as in some of the oils, the globe separator (see Fig. 332), or the pear shaped separator (see Fig. 333), which can be securely stoppered and evaporation prevented, is preferred. In the assay processes, when immiscible liquids are to be separated, this latter form is invaluable, because, on account of the narrowing of the lower portion, the point of separation of the liquids can be more accurately fixed.

Fig. 333

Pear shaped separator

Fig. 334



Mitchell's separator

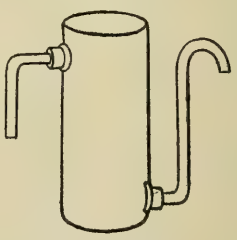
Mitchell's Separator.—Dr. Mitchell devised a cheap but efficient substitute for the separating funnel (see Fig. 334). A good, well pressed cork, C, is fitted into the throat of a funnel, E, and the end of a penholder handle, H, or other suitable wooden rod, is whittled to a flat wedge, and this forced into the cork tightly. The lower portion of the holder is notched, and the upper part of the cork is tied securely to it, or a wooden pin may be driven through it and the cork, to fasten it. It is used by forcing the cork C into the neck of the funnel, pouring in the liquids, and, when they have separated, lifting the handle H carefully until the lower liquid has entirely escaped, and then pushing it down tightly to stop the flow.

Florentine Receiver.—The separation of volatile oils from the water which usually accompanies them during distillation is a very

Fig. 335

Florentine receiver

Fig. 336



Receiver for light and heavy oils

important part of their process of manufacture. Where the volatile oil is lighter than water, the form shown in Fig. 335 is used. The mixed oil and water collect in the glass receiver during distillation, the oil floating on the top, while the water ascends the bent tube from

the bottom ; further addition of distillate causes an overflow, and the water from the bottom of the receiver is discharged through the tube into a suitable vessel ; then the receiver becomes filled again gradually as distillation progresses. The process of separation is continued automatically. Where the oil is heavier than water, the method is reversed, and provision must be made for the escape of the water near the top of the receiving vessel. Labor may be saved by the use of a long necked funnel, or by placing a funnel in a wide tube, so that the mixed oil and water may be conveyed at once to the bottom without the liability of some particles of oil being carried over through the lateral tube and necessitating a second separation.

Fig. 336 shows a receiver which can be used for either light or heavy oils, one or the other tube being stopped with a cork, as the case requires.

CHAPTER XIV

PRECIPITATION

PRECIPITATION is the process of separating solid particles from a solution by the action of heat, light, or chemical substances. The separated solid is termed a *precipitate;* the added liquid or substance which produces the precipitate, the *precipitant;* the liquid which remains in the vessel above the precipitate, the *supernatant liquid.*

The precipitate usually falls to the bottom of the vessel. It may, however, remain suspended or rise to the top.

The objects of precipitation in pharmacy are,—

1. To obtain conveniently solid substances in the form of fine powder. Example, the precipitation of calcium carbonate.

2. To effect the purification of solids. Example, the precipitation of pepsin from its solution by sodium chloride.

3. To obtain through chemical reaction substances which are insoluble in the supernatant liquid. Example, the official preparation of red mercuric iodide.

Precipitation is largely used in testing, as it frequently affords the most ready means of recognizing chemical substances or of ascertaining their purity. A great many pharmacopœial tests are based upon this process. The color, quantity, and character of the precipitate are all taken into account. The terms *curdy, granular, flocculent, gelatinous, crystalline, bulky,* and others, which are sufficiently distinctive, are used to define the peculiar form which the precipitate assumes when thrown out of solution. A *magma* is a thick, tenacious precipitate left after the liquid is decanted.

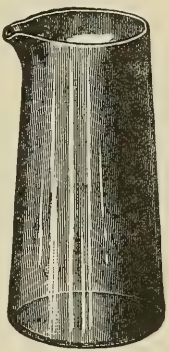
Methods of Effecting Precipitation.—Precipitation may be produced in many ways. If solutions containing albuminous matter be *heated,* a flocculent precipitate of coagulated albumin will be thrown down; while if solution of the silver salts be exposed to the *light,* precipitation is apt to take place. Precipitation will usually occur when a hot saturated solution of an amorphous substance is allowed to cool, as in the preparation of antimony oxysulphide, or when to a solution is added a liquid in which the dissolved substance is insoluble, as when strong alcohol is added to a small quantity of mucilage of acacia, or water to an alcoholic solution of guaiac.

Precipitation is most generally effected by the reaction of chemical substances, and some of the most interesting processes in pharmacy are the results of this method of producing precipitates. When acid solutions are brought in contact with alkaline solutions, insoluble precipitates are sometimes formed, as the solution of oxalic acid with lime water, forming calcium oxalate. By far the most common method is to mix a solution of one salt with a solution of another, thereby producing an insoluble precipitate, as in the official process

for preparing red mercuric iodide, where solution of mercuric chloride and solution of potassium iodide are together poured into water. The methods of producing precipitates are numerous, and will be noted in detail under the head of the respective substances.

Vessels used in Precipitation.—Precipitating vessels should be deep, comparatively narrow, and broader at the bottom than at the top (see Fig. 337). This construction permits the precipitate to occupy less height in the vessel, by causing it to spread out upon the bottom; thus the supernatant liquid can be more thoroughly decanted, the particles of the precipitate will lie in closer contact, and a better opportunity is given for the escape of imprisoned air or gas, which frequently exercises a buoyant effect on the particles and prevents their subsiding rapidly and closely. Upon the large scale, cedar tanks, of the shape just described, may be used; these may have wooden spigots introduced, a foot or so apart, so that the supernatant liquid may be conveniently run off.

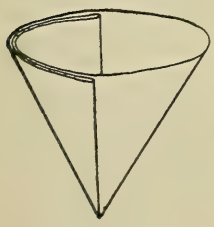
Fig. 337



Precipitating jar

Manner of conducting the Process.—If two solutions are used, and it is known that they contain the exact quantity of solid substance to react mutually without leaving an excess of one or the other, the order in which the liquids are mixed is immaterial; but when this is not the case, and the precipitant is to be added until precipitation ceases, it is necessary to proceed with caution. The precipitant is then added gradually, and, where acid or alkaline solutions are used, litmus paper is useful in indicating the approach of an excess. In other cases the precipitate may be allowed to subside, and the precipitant slowly dropped into the clear liquid above until it is noticed that further addition is without effect. If the precipitate is too bulky to subside quickly, the whole may be vigorously stirred until thoroughly mixed, a small portion transferred to a small plain filter (see Fig. 338), and the filtrate tested by a further addition of precipitant. If this small portion is weighed, or measured, or is a known proportion of the whole, a simple multiplication will determine about the quantity necessary to complete the precipitation. Ammonia water is one of the most useful of alkaline precipitants, because an excess is at once noticed by the odor. This is easily done by blowing the air from the surface of the liquid, thoroughly stirring up the mixture, and then noting whether it smells of ammonia.

Fig. 338

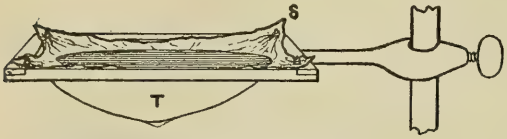


Filter (for precipitates)

The Production of Heavy and Light Precipitates.—Hot, dense solutions usually produce heavy precipitates, and such precipitates are more readily washed from adherent contaminating salts than those which are light and bulky. An additional advantage is, that they occupy less space, and consequently their dose is less bulky. A good example of this is found in the manufacture and use of heavy and light magnesium carbonate.

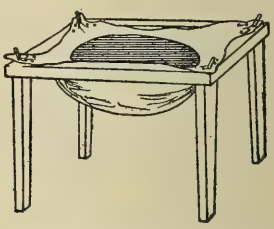
Collecting and washing Precipitates.—In small operations precipitates are collected upon plain filters (see Fig. 338). The special advantages of such filters in this respect have been already pointed out on page 230. On a larger scale muslin strainers are generally

FIG. 339



Collecting a precipitate

FIG. 340



Frame and strainer for precipitates

used. These are suspended on frames, as shown in Figs. 339 and 340. In washing precipitates which are placed on strainers of this kind, care must be observed to close up the fissures which usually appear in the magma after it has been allowed to stand a short time, by stirring the precipitate thoroughly before adding more water. (See Lotion, Decantation, pages 222 and 223.)

QUESTIONS ON SEPARATION OF IMMISCIBLE LIQUIDS AND PRECIPITATION

What is a pipette, and how is it used? (See page 249.)
What is a separating funnel, and how is it used?
What are the advantages and uses of the pear-shaped separator?
Describe Dr. Mitchell's separator.
What is a Florentine receiver?
What is precipitation? (See page 252.)
What is the separated solid termed?
What is the substance which produces the precipitate termed?
What is the liquid which remains in the vessel above the precipitate called?
What are the objects of precipitation in pharmacy?
Give examples of each of these objects.
How and why is precipitation used in testing?
What descriptive terms are used for the precipitate?
What is meant by the term "magma"?
What various methods are there of effecting precipitation?
What is the best shape for precipitating vessels?
If two solutions are used to produce a precipitate, in what order should they be mixed?
If an acid and an alkaline solution are mixed, how may it be determined when the mixture is neutral, or nearly so?
Why is ammonia the most useful of alkaline precipitates?
How are heavy precipitates formed?
Are they more or less easily washed from adherent salts than light precipitates?
What advantage have heavy precipitates over light ones?
How should a filter be folded for collecting a precipitate in analytical work?
How may large amounts of precipitates be collected and washed?

CHAPTER XV

CRYSTALLIZATION

CRYSTALLIZATION is the process whereby substances are caused to assume certain determinate forms called *crystals*. These are distinctive, and when perfect are bounded by geometrical surfaces. Those substances which are *not* crystallizable are termed *amorphous*. The objects of the process are to increase the purity and to enhance the beauty of chemical substances. The descriptions of the crystalline forms assumed by bodies form the basis of the interesting science of *crystallography*. In a work of this kind it is impossible to give more than a very brief sketch of the outlines of the classification, since the practical process of crystallization must receive the most attention. (See Dana's Mineralogy, Kopp's Kyrstallographie, Miller's Mineralogy, etc.). Every crystallizable body invariably assumes its own characteristic form, or in some form directly derived from it or related to it by a simple law, and in order to classify them crystallographers recognize at the present time six systems, to one or other of which every crystal is referred. A seventh system is sometimes conceded, but the occurrence of crystals belonging to it has not been demonstrated with certainty.

The following definitions should be well understood: The plane surfaces bounding a crystal are termed *faces;* when two contiguous faces intersect, an *edge* is formed; an *angle* is formed when three or more faces intersect.

The faces, edges, or angles of a perfect crystal have equal faces, edges, or angles opposite to them, and if the middle points of the opposite faces or edges, or the opposite angles, be joined by straight lines, the point at which these lines intersect will be the centre of the crystal. The lines drawn through this point are called *axes*.

When *the same* body crystallizes in two or more forms belonging to different systems, it is said to be *dimorphous, trimorphous, polymorphous*, etc. When *different* substances crystallize in the same form, they are said to be *isomorphous*.

Prismatic (or prism-like) *crystals* are those which are extended principally in the direction of their longest axis. *Tabular crystals* are those crystallizing in flat plates; *laminar*, those crystallizing in thin plates; *acicular*, those which are needle shaped, etc.

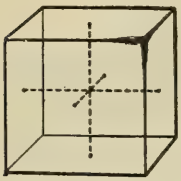
Other terms are used to describe the physical characters of crystals, which are readily understood and are not technical in their meaning.

The systems of classification are based upon the length and relative position of the axes of the crystal. Those in which the three axes intersect at right angles are termed *orthometric;* and when the angles caused by their intersection are oblique, they are called *clinometric*.

Systems in Crystallography

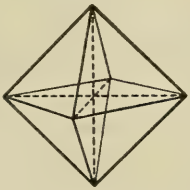
I. Monometric, or Regular System.—The crystals have three axes of *equal* length intersecting at right angles (see Figs. 341, 342, 343, and 344).

Fig. 341



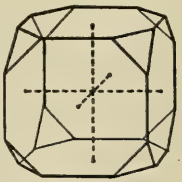
Cube

Fig. 342



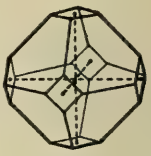
Octahedron

Fig. 343



Truncated cube

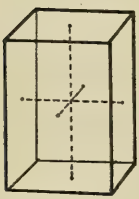
Fig. 344



Truncated octahedron

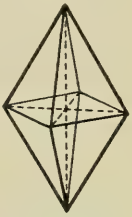
II. Dimetric, or Quadratic System.—The crystals have three axes, two of which are *equal*, the other *different* in length, all intersecting at right angles (see Figs. 345, 346, 347, and 348).

Fig. 345



Right square or dimetric prism

Fig. 346

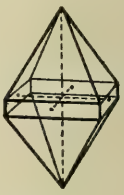


Dimetric octahedron

Fig. 347

Square prism, pyramidal summits

Fig. 348



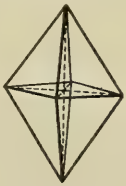
Square prism, pyramidal summits

III. Trimetric, or Rhombic System.—The crystals have three axes of *unequal* length, all intersecting at right angles (see Figs. 349, 350, 351, and 352).

Fig. 349

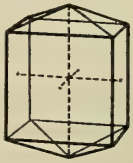
Rhombic prism

Fig. 350



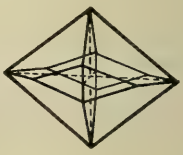
Rhombic octahedron

Fig. 351



Rhombic prism, pyramidal summits

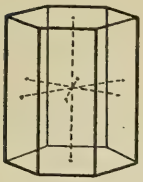
Fig. 352



Rhombic octahedron (partially truncated)

IV. Hexagonal, or Rhombohedric System.—The crystals have four axes, three of *equal* length, in the same plane, and inclined to one another at angles of 60°. The fourth axis is *different* in length, and intersects the plane of the other three at right angles (see Figs. 353, 354, 355, and 356).

FIG. 353

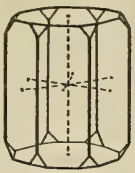


Hexagonal prism

FIG. 354

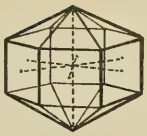
Double hexagonal pyramid

FIG. 355



Hexagonal prism (truncated)

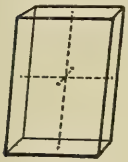
FIG. 356



Hexagonal prism, pyramidal summits

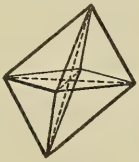
V. Monoclinic, or Oblique Prismatic System.—The crystals have three axes of *unequal* length, two of which are obliquely inclined to each other, the other axis forming right angles with these two (see Figs. 357, 358, 359, and 360).

FIG. 357



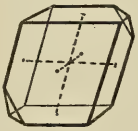
Monoclinic prism

FIG. 358



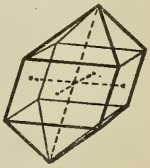
Monoclinic octahedron

FIG. 359



Monoclinic prism (partly truncated)

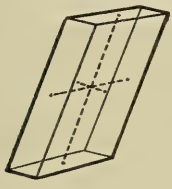
FIG. 360



Monoclinic prism, pyramidal summits

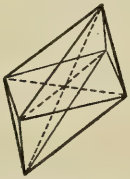
VI. Triclinic, or Doubly Oblique Prismatic System.—The crystals have three axes of *unequal* length, all obliquely inclined to one another (see Figs. 361, 362, 363, and 364).

FIG. 361



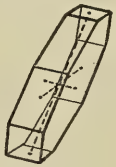
Triclinic prism

FIG. 362



Triclinic octahedron

FIG. 363



Triclinic prism (truncated)

FIG. 364

Triclinic octahedron (partly truncated)

The Diclinic System, if recognized, would have three axes, two at right angles to each other, the third oblique to the other two.

Determination of Crystalline Form.—The method of determining the position of a crystal in one or other of the systems above noted is to measure the inclination of the angles which the faces of the crystal make with one another. From the data obtained the length and inclination of the axes are calculated. The hand goniometer or Wollaston's reflecting goniometer is used to measure the angles.

Cleavage.—If a crystal of potassium ferrocyanide or a piece of mica is broken and examined, it will be noticed that the cohesion of the particles is less in one direction than in any other, and if the blade

of a knife is inserted in the edge, the crystal may be easily split or cleft. Other crystals possess this property, but to a greatly varying extent. Perfect crystals may sometimes be formed by cleavage.

The process of crystallization generally takes place when a body passes from a liquid or a gaseous condition into the solid state. A few instances are known where amorphous solids become crystalline without becoming liquefied, as in iron or brass wire, sulphur, barley sugar.

Methods of Obtaining Crystals.—1. By fusion and partial cooling. 2. By sublimation. 3. By deposition from supersaturated solutions as they cool. 4. By deposition from solutions during evaporation. 5. By deposition from solutions upon passing through them a galvanic current. 6. By precipitation. 7. By the addition of a substance having a strong affinity for water.

1. **By Fusion and Partial Cooling.**—Substances which have low melting points, like sulphur, camphor, and iodine, and some of the metals, like bismuth, antimony, etc., may be crystallized in this way. To obtain crystals of a substance like sulphur, it should be melted in a deep vessel and then allowed to cool, so that a crust will be formed; a hole is then made in the crust, and a smaller one on the opposite side; the vessel is now inclined toward the side having the larger hole, and the melted substance runs off; when the surfaces inside are examined, they will be found studded with crystals. If the quantity of material used is large, and the mass has been gradually cooled, the crystals will be large and distinct. The crust should be perforated as soon as it is fairly formed, and the fluid contents quickly removed.

2. **By Sublimation.**—This is one of the most useful methods of obtaining crystals (see Sublimation, page 181).

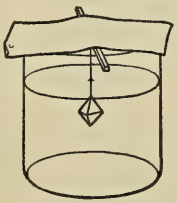
3. **By Deposition from Supersaturated Solutions.**—This is the method by far most frequently employed to obtain crystals. The solution of the substance is generally effected by the use of heat (see Solution). This solution should be filtered, and evaporated to the proper degree, and this latter part of the operation is the most important in determining the size and beauty of the crystals. As a rule, concentrated solutions produce small, ill defined crystals, while comparatively dilute solutions, provided they are supersaturated, produce crystals of more perfect form. The proper degree of concentration must always depend upon the solubility of the substance. If very soluble, the solution should not be saturated at the boiling temperature, or the crystals will be very small and so thoroughly interlaced that it will be difficult to wash them; if a portion of the evaporating solution is transferred to a glass or porcelain plate and allowed to cool, the rapidity with which the small quantity of solution crystallizes, and the amount of crystals obtained, form a basis for judgment. Upon the large scale, in order to secure a uniform product, it will be found that the specific gravity of the solution at a definite temperature, the temperature of the air, and the quantity of the solution must be considered. These points, however, can be obtained only by experience, and after a practical trial with each substance. It is a good habit to keep a record at each operation of the specific gravity and temperature of the solution which is set aside to crystallize, and note the character of the product. If the substance

is not very soluble, the solution should be evaporated until a *pellicle* or crust is formed upon the top, and then set aside.

Perfect rest for a solution designed for crystallization must be secured, if well defined crystals are wanted, and the solution must not be cooled quickly. When small crystals are desired, as in the case of magnesium or zinc sulphate, the solution should be cooled quickly, with constant agitation. This produces a great many nuclei, and prevents the gradual deposition of the particles in regular order upon one nucleus, which is so essential to the formation of the perfect crystal. There are several plans to choose from, for preventing rapid cooling. If the liquid is placed in an evaporating dish, and heated in a sand bath or water bath until evaporated to the proper point, the whole may be set away without disturbing them, to cool slowly together; or the dish may be placed in a warm room which is slowly cooled; or it may be embedded in a blanket or in woollen cloths, covered, and set aside. Having arranged the dish, it must be left absolutely undisturbed until all the crystals have separated. If jarred or knocked after the crust has once formed, the crystals will be mere confused masses.

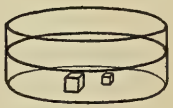
Use of Nuclei.—It has long been known that if a smooth glass rod having a single scratch upon it be placed in a solution ready to crystallize, crystals will first attach themselves to the scratched part, and the smooth part of the rod will frequently not have any separate crystals upon it. Rough surfaces, by offering more points of adhesion, attract the nuclei upon which the crystalline body is subsequently deposited. It is for this reason that strips of wood or lead are frequently suspended in liquids intended for crystallization, while in the manufacture of rock candy, threads are usually strung across the crystallizing tubs at regular intervals, columnar masses of fine crystals being thus produced. Perfect geometrical crystals may be obtained by the practice of "nursing," which consists in selecting from the ordinary stock as perfect a crystal as can be found for the nucleus, and then suspending it by a horsehair or piece of sewing silk in a warm saturated solution of the salt. Prof. J. U. Lloyd contributed to New Remedies, in 1879, pages 98, 133, 162, some interesting notes on the production of perfect crystals. Figs. 365 and 366 illustrate the method of "growing" perfect crystals.

FIG. 365



"Growing" crystals

FIG. 366



"Growing" crystals

Retarded Crystallization.—Warm saturated solutions of various salts, particularly if contained in chemically clean vessels, protected from the dust, and left at absolute rest until cooled, usually fail to crystallize. If the receptacle is shaken or jarred, or if a crystal from which the solution has been made, or any other solid substance, is dropped into it, crystallization sometimes takes place in an instant, and considerable heat is evolved. This is particularly noticed with salts capable of crystallizing with more than one molecule of water, as sodium sulphate, sodium carbonate, etc.

4. **By Deposition from Solutions during Evaporation.**—This process is not so frequently resorted to as that of cooling from hot saturated solutions, but it is especially useful where the liquid is more volatile than water, as alcohol, ether, petroleum benzin, chloroform, and upon the small scale for experimental purposes, or in the processes of original investigation. There are some instances in manufacturing pharmacy where the method is used, but in the case of volatile liquids the expense attending their loss, if spontaneously evaporated, is great, and, as a usual thing, rapid evaporation or recovery of the solvent by distillation cannot be used where large and distinct crystals are desired. Beautiful crystals are often made from aqueous solutions of substances that are allowed to evaporate slowly in a warm room for several months. The quantity of liquid and the amount of solid in solution have a great influence in enhancing the beauty of the product. For this reason it is usually impossible for the pharmacist operating on the small scale to vie with the manufacturer in producing massive crystals; there is compensation, however, to the pharmacist in obtaining increased knowledge of the properties of medicinal chemicals and absolute knowledge of their purity.

5. **By Deposition from Solutions upon passing Feeble Electrical Currents through them.**—This method is mentioned in this connection because Becquerel and others have produced crystals of metals and metallic oxides by the slow but continuous action of feeble electrical currents through the solutions, kept up for months, sometimes for years. Gold and copper may be beautifully crystallized in this way.

6. **By Precipitation.**—Crystals are produced in some cases by the precipitation resulting from the mixture of certain solutions, and in other ways. (See Precipitation.) The crystals formed by this method are granular, and, on account of their rapid growth, are not well defined. A crystalline precipitate of acid potassium tartrate is produced when solution of potassium hydroxide is added to a strong solution of tartaric acid.

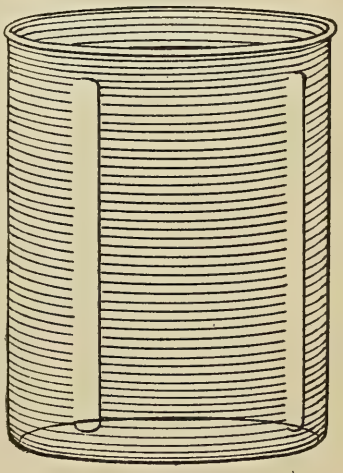
7. **By the Addition of a Substance having a Strong Affinity for the Liquids of the Solution.**—This method of effecting the crystallization of a solid is resorted to in some special cases. If calcium chloride is added to an aqueous solution of sodium chloride, the latter crystallizes out. Alcohol mixed with a solution of potassium nitrate causes the crystallization of the salt, because alcohol and water unite, and the potassium nitrate is not soluble in the mixture. The crystallization of sugar is frequently observed in syrups to which alcohol in the form of a tincture or fluidextract has been added, and this is often a source of annoyance to the pharmacist.

Water of Crystallization.—Many substances in the act of crystallizing combine with water, and the water so combined is termed *water of crystallization.* The same substance does not always contain the same number of molecules of water of crystallization. Sodium carbonate, for instance, usually contains ten molecules. At higher temperatures it may be made to crystallize with eight or with but five molecules, and under some circumstances it contains but one molecule of water. This combination with water must be carefully distinguished from the mechanical retention of water in the interstices of crystals,

which takes place particularly where the crystals are large and have been formed rapidly. Water retained in this way is termed *interstitial water*, or *water of decrepitation*, because it is the cause of the *decrepitation* of bodies when exposed to heat. The sudden expansion of the water causes the substance to crackle and burst into fragments. Crystals containing combined water lose part of it on exposure to the atmosphere, and the transparency noticed when the crystal was fresh is replaced by opacity and the formation of a dry powder on the surface. This change is termed *efflorescence*. There are very few substances which will part with all their water of crystallization at ordinary temperatures, nearly all requiring a high heat to effect the object. The act of driving off the water and reducing the crystals to the form of a dry powder is called *exsiccation*. Some substances absorb water from the atmosphere, and, instead of becoming dry, grow moist, and in some cases are converted entirely into liquids. Such substances are said to be *hygroscopic*, and the act is termed *deliquescence*. A good example is found in potassium carbonate which has been exposed to moist air.

Mother Liquor.—The liquid remaining after the crystals have formed is called mother liquor, and still contains some of the salt in solution. This liquid retains as much of the solid as the solubility of the latter and the temperature will permit. It may be evaporated, and another crop of crystals obtained, if desired. Where two salts are in solution, it is obvious that the more soluble salt must exist in largest proportion in the mother liquor. Hence salts are frequently separated from each other by taking advantage of their difference in solubility. Thus cinchonine is separated from quinine. The process is termed *fractional crystallization*.

Fig. 367



Appert glass tank

Crystallizing vessels should be deep, and made of rough glazed stoneware or porcelain. On the large scale, wooden tanks or vats are employed. The Appert glass tanks with heavy glass covers are very useful, as they cannot color the crystals or liquid (see Fig. 367). In the crystallization of alum the staves of the vats are retained in place by iron hoops, which may be tightened or loosened by screw bolts. After the solid crust of alum is formed around the sides and bottom, the hoops are loosened, the staves removed, and a hole chiselled through the side crust near the bottom, to permit the mother water to escape.

Collection, Draining, Washing, and Drying of Crystals.—Upon the small scale it is usually sufficient, after the mother water is decanted, to break the crust of crystals, and, having dropped a few pieces of clean broken glass in the throat of the funnel, to place the crystals

upon them and drain thoroughly. They are then to be washed by pouring water carefully and sparingly upon them. If the crystals are very soluble in water, and it is necessary to free them entirely from mother liquor, they must either be washed with alcohol or some liquid in which they are not so soluble, or with ice cold water, used very carefully but quickly by pouring it drop by drop upon the crystals, so that the smallest quantity will suffice. After draining, they may be transferred to a double sheet of filtering paper, placed on a bed of two or three newspapers or cloths, loosely covered, and removed to a dry atmosphere. If the crystals are liable to effloresce, they should be turned several times, and bottled as soon as fairly dry. Deliquescent crystals, like those of chromium trioxide, may be dried by spreading them on a clean, red pressed brick in a dry room. The mother water will be gradually absorbed by the brick, and as soon as the crystals are dry they are transferred to a close vessel.

Intermediate crystallization is a term used to define the process of crystallizing a substance which is comparatively insoluble in simple solvents, by causing it to dissolve in a hot solution of another substance. Of course the latter should be very soluble. The whole of the ordinarily insoluble salt will entirely crystallize out at the first attempt. Red mercuric iodide may be made to crystallize in this way in brilliant scarlet crystals by dissolving it in a hot solution of sodium chloride, potassium iodide, or mercuric nitrate.

QUESTIONS ON CRYSTALLIZATION

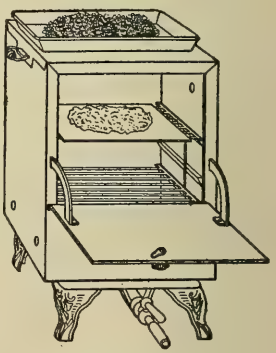
What is crystallization? (See page 255.)
What are non-crystallizable substances called?
In the classification of crystals, how many systems are recognized?
What is meant by the center of a crystal?
What is meant by the axes of a crystal?
What are substances called that crystallize in two forms? In three forms? In more than three forms?
What are prismatic crystals? Tabular crystals? Laminar crystals? Acicular crystals?
Upon what are the systems of classification of crystals based?
What are those called in which the three axes intersect at right angles?
What are those called in which the angles caused by the intersection are oblique?
Describe the monometric, or regular system. The dimetric, or quadratic system. The trimetric, or rhombic system. The hexagonal, or rhombohedric system. The monoclinic, or oblique-prismatic system. The triclinic, or doubly-oblique prismatic system. The diclinic system.
How can the form of a crystal be determined as to which system it belongs?
What is the instrument for measuring the angles of crystals called?
What is meant by cleavage?
Under what circumstances does the process of crystallization generally take place?
Do solids ever become crystallized without becoming liquefied?
Give an example.
By what various methods may crystals be obtained?
How may crystals be formed by fusion?
Do weak or strong solutions form crystals of the most perfect form?
How may large crystals be obtained?
How may small crystals be obtained?
Are crystals more readily deposited on rough or smooth surfaces?
How may perfect geometrical crystals be produced?
In what cases is the process of obtaining crystals by evaporation useful?
How may gold and copper be crystallized?
Give an example of the production of crystals by precipitation.
Also when two solutions are mixed together.
Why does the addition of alcohol to syrup cause the sugar to crystallize?
What is water of crystallization?
What is interstitial water?
What is water of decrepitation, and why is it so called?
What is efflorescence?
What is exsiccation?
What substances are hygroscopic?
What is deliquescence?
Give an example of a deliquescent salt.
What is mother-liquor?
What is meant by fractional crystallization?
How should crystallizing vessels be made?
How is alum usually crystallized?
On the small scale, how may crystals be obtained?
What is meant by intermediate crystallization?

CHAPTER XVI

GRANULATION AND EXSICCATION

By granulation is meant the process of heating the solution of a chemical substance, with constant stirring, until the moisture has evaporated, and a sabulous, coarse grained powder is produced. It is a convenient method of obtaining many substances in the form of powder. Indeed, the practical advantages of granulated powders are so well recognized now at the prescription counter, that their use in preference to large crystals is rapidly extending. This is particularly the case with salts which are not very soluble in water, or which are commonly found in commerce in hard, tough, crystalline lumps or masses. The process of granulation is one which requires care, but no great amount of skill. The solution of the substance is generally evaporated rapidly until a pellicle forms upon the surface. Then the heat is moderated, in order to prevent spurting and caking. Great care must be exercised at this stage of the process to stir the mass constantly, as the tendency to form a crust on the bottom is very great, and when this hard crust is broken up by the stirrer it is very difficult to avoid the formation of lumps ; but if the crust is not allowed to form, by keeping the bottom of the dish clean through constant stirring, the salt will separate in distinct grains, which will not adhere to each other. Toward the end of the process the heat should be very moderate, and the product should be introduced at once into a clean, warm, dry bottle.

Fig. 368



Oven for drying granulated effervescent salts

Granulated effervescent salts were formerly made by mixing the dry powders with dry tartaric acid and sodium bicarbonate and moistening the mixture with strong alcohol. The pasty mass was passed through a sieve, and the granules dried quickly in a hot room, sifted, and filled into bottles, which were hermetically sealed to prevent the access of moist air.

The use of alcohol in making granulated effervescent salts is expensive, and an improvement was made by using citric acid to replace a part of the tartaric acid. The molecule of water of crystallization in citric acid is liberated when heated in contact with the sodium bicarbonate, and this furnishes just sufficient water to make a pasty mass, without causing much loss of carbonic acid ; by quickly drying the granules further chemical action is prevented.

In 1903 E. Fullerton Cook improved this method by mixing the powders in a flat enamelled dish and heating in an oven to about 100° C. (212° F.). When the mixture becomes moist, it is manipulated with

a wooden spatula to make it uniform in consistence, and rubbed through a coarse tinned-iron sieve and the granules dried on the top of the ovens. Fig. 368 shows a convenient oven for this use. A gas stove or wickless blue flame stove may be employed, and it is possible for a pharmacist to make granulated effervescent salts on the small scale.

The National Formulary has given the following general directions for the preparation of granular effervescent salts:

"The citric acid directed in the formulas should be uneffloresced crystals and be finely powdered just before using. All other ingredients should be well dried at a temperature not exceeding 50° C. (122° F.) until they cease to lose weight, and then finely powdered and passed through a No. 60 sieve. As atmospheric dampness, if present, will be absorbed by the finished salt and destroy the effervescent character of the product, it is important that these preparations be made in an atmosphere free from moisture.

"*Directions for Granulating in an Oven.*—Having prepared the citric acid and the other ingredients of the formula as directed above, intimately mix the powders, without trituration, adding the citric acid last, and spread the resulting product evenly, about 10 mm. thick, on a sheet of paper on a canvas tray, glass plate, or in a shallow porcelain or enamelled dish, and place it in an oven, heated to a temperature between 95° and 105° C. (203° to 221° F.). Allow the powder to remain in the oven, without stirring, until it becomes moist and acquires the proper consistence, about that of dough, then force the mass immediately through a No. 6 tinned-iron sieve and dry the product at a temperature not exceeding 50° C. (122° F.). When dry, again pass the granular powder through a No. 6 tinned-iron sieve, and immediately transfer it to dry bottles or containers, and hermetically seal them.

"*Directions for Granulating on a Water Bath.*—If a small quantity of the salt is to be prepared, the powders, mixed as directed above, may be transferred to a covered dish on a water bath or to a double boiler, heated by water actively boiling, the inner dish being in contact with the water, and the resulting pasty mass stirred until dry. The dry granules should be immediately passed through a No. 6 tinned-iron sieve and transferred to a dry container, which should then be hermetically sealed."

In the manufacturing laboratory the mixture is usually heated in a shallow, enamelled, jacketed steam kettle until moist, then forced through a No. 6 tinned-iron sieve by mechanical means and the moist granules dried in a vacuum dryer.

Exsiccation is the process of depriving a solid crystalline substance of its water of crystallization or moisture by heating it strongly.

The product is usually a fine powder, and the original crystalline condition of the substance may be restored by redissolving it and evaporating the solution. The process is conducted by exposing the crystals to the air or to a warm temperature until they are effloresced, and then gradually heating, with stirring, until they cease to lose weight; the residue is then powdered and kept in well stoppered containers. The object of exsiccation is to increase the strength of substances and thereby fit them for special applications.

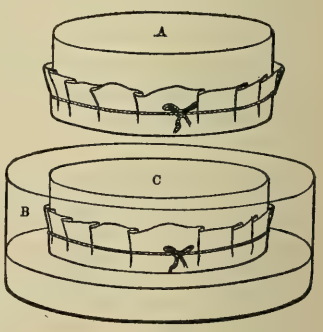
CHAPTER XVII

DIALYSIS

Dialysis is the process of separating crystallizable substances from those which do not crystallize, by placing a mixture of their solutions upon a porous diaphragm which has its under surface in contact with water. This remarkable process was discovered by Graham in 1861. He termed the substances which had the power of passing through the septum or diaphragm *crystalloids*, because they always have the crystalline form, and those which remained upon the diaphragm *colloids*, from their resemblance to gelatin and because they never crystallize. He also pointed out the differences between the two classes. Crystalline bodies, or crystalloids, are diffusible, brittle, hard, with clearly defined angles and flat faces. Their solutions are free from viscosity, and their reactions energetic and quickly effected. (Example, strychnine.) Colloidal bodies, on the other hand, are not diffusible. They are tough, with more or less softness of texture. The mathematically arranged angles and faces of crystals are replaced in colloids by rounded, irregular outlines, the fracture often being curved or conchoidal. Water of crystallization is replaced by water of gelatination, and the solution of colloids is, when concentrated, viscous or gummy, and their reactions are sluggish or inert. (Examples, gum, glue, starch, dextrin, gelatin, albumin, extractive matter.)

A thin layer of gelatin interposed between two liquids offers no obstacle to the passage of the crystalloids from one to the other, while it completely prevents the passage of the colloids. This property belongs not only to gelatin, but to other substances having a similar molecular constitution, as bladder, parchment, etc., of which the most convenient is the texture known as *parchment paper*, prepared by immersing unsized paper in a *cold* mixture of two measures of sulphuric acid and one of water, and subsequently washing it thoroughly to free it from acid.

Fig. 370

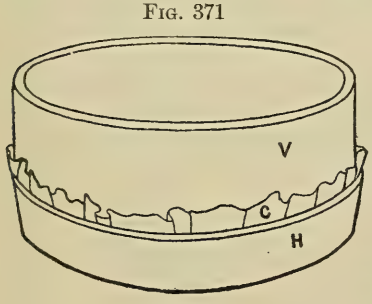


Dialyzer

Upon the principles stated above Prof. Graham contrived a very simple apparatus which he called the dialyzer (see Fig. 370). It consists of two parts, one a circular glass recipient (B), about a foot in diameter and six inches deep, the other (A) a similar circular vessel, from six to ten inches in diameter and about two inches deep, made of hard rubber, celluloid, glass, or some similar substance, and the bottom of a circular piece of parchment paper, the edges of which are brought over the lower rim of the inner vessel nearly to the top, and

fastened securely outside of it by a string or by a narrow rubber band. The first part, or circular basin, is to receive distilled water, and should contain from five to ten times the quantity of the liquid that may be introduced into the smaller vessel. The latter is to float upon the surface of the water in the former, and is to receive the liquid to be submitted to dialysis, which should not be more than half an inch deep on the paper bottom. It is important that the parchment paper employed should have no rent or aperture, and should be brought well up and secured on the outside of the inner vessel to prevent the liquid from passing between them. If any liquid containing a mixture of colloidal and crystalloidal matter be placed in the floating vessel, after some hours it will be found that a portion of the latter has passed through the parchment paper, and is held in solution by the distilled water of the larger vessel, while the colloidal matter remains. The distilled water thus impregnated is called the *diffusate*. The parchment paper, or any similar material used as the septum, is applicable to the dialysis of substances held in aqueous solution only, and will not answer for alcoholic or ethereal liquids. The hard rubber sieve, which has been already noticed (see Fig. 371), makes an excellent dialyzer if floated upon pure water in an evaporating dish or beaker. Fig. 372 shows another form, in which the glass dialyzer has its upper edge expanded into a flat shoulder which rests upon the upper edge of the round dish, sometimes called the "exarysator," containing the water. This has the advantage of keeping the diffusate covered while the dialysis is progressing. It is obvious that very different arrangements might be made to accomplish the same ends. Thus, a thoroughly clean bladder three-fourths filled with a mixture, suspended in a jar of distilled water, would yield similar results. Graham's apparatus is preferable to others only for its convenience.

Fig. 371



Dialyzer

Fig. 372

Dialyzer (glass)

The following applications of the process of dialysis have been made: 1. It facilitates in many instances to a considerable extent the separation of the active matter of any artificial or natural mixture from the inert and useless, the former being very often crystalline and the latter colloidal. Thus, infusions or decoctions of medicines, such as opium, belladonna, aconite, etc., submitted to dialysis might give up more or less completely their crystalline principles, such as the salts of morphine, atropine, aconitine, etc., to the water, while the gummy, resinoid, extractive, and coloring matters, etc., might remain behind. In effecting the analysis of organic bodies, one of the most embarrassing problems is to get rid of the inert principles

which interfere with the action of chemical reagents, and the process of dialysis may here often be brought to the aid of the operator. 2. In searching for poisons in organic mixtures, as in the contents of the stomach, in which the application of tests is often rendered abortive by the colloidal matter present, the problem of the presence of the poison may sometimes be solved by submitting the suspected matter to dialysis. The poison will often be found in the diffusate separated from the other matters, and may then be detected by the ordinary tests. 3. In pharmaceutical operations it often happens that salts and other crystallizable substances are thrown away as refuse matter because they would not repay the cost of time and material necessary for their recovery. It is possible that by this simple, inexpensive process these substances may be separated from the useless matters and thus saved. 4. An economical application has been made of the process, by the restoration of salted meat to the fresh state. If some salt beef with its brine be enclosed in a bag of material suitable for dialysis, as of untanned leather, and the bag be immersed in sea water, in the course of some days the beef will have been rendered sufficiently fresh for use, the salt having passed out into the sea water. 5. A number of extensively used forms of medicine are colloidal in character. *Colloidal silver*, used as an antiseptic, *colloidal iron*, recommended for anemia, *colloidal bismuth*, *calomel*, *gold*, *copper*, etc., are all known and used.

The application of the laws governing *colloidal solutions* and preparations is receiving much attention today in medicine, pharmacy, and in commercial arts. For a brief discussion of the subject see the chapter on Solutions (page 221).

Dialyzed iron, or *Ferrum Dialysatum*, is a colloidal preparation made by placing a mixture of basic ferric chloride and ammonium chloride upon a septum. The crystalloids (ammonium chloride and ferric chloride), with any free acid, pass into the diffusate, leaving the neutral colloidal liquids upon the septum.

QUESTIONS ON GRANULATION, EXSICCATION AND DIALYSIS

What is meant by granulation? (See page 264.)
How were granulated effervescent salts formerly prepared?
How are granulated effervescent salts now prepared?
What should be the condition of the citric acid for use in effervescent salts? Why?
What should be the condition of all ingredients other than citric acid? Why is atmospheric dampness objectionable?
Describe the detail for granulating in an oven. For granulating in a water bath.
How are granular effervescent salts usually made on the large scale?
What is exsiccation, and what is its object? What is dialysis?
What are crystalloids? Give an example. What are colloids? Give examples.
What is the most convenient substance to use for a dialyzing medium?
How is it prepared?
Describe Professor Graham's dialyzer.
What is the liquid called in which crystalloid matter is dissolved, which has been passed through a dialyzer?
What applications of the process of dialysis have been made?
What preparations have been called dialysates? What is dialyzed iron?

CHAPTER XVIII

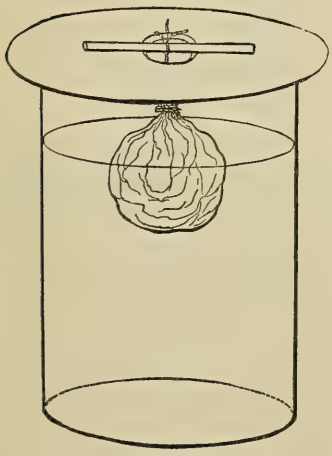
EXTRACTION

UNDER this head are included those operations which have for their object the separation of the soluble principles from drugs by treating them with a liquid capable of dissolving them, which is called the *menstruum*. Extraction differs from solution in the fact that the presence of insoluble matter is implied in the former, and the soluble constituents must therefore be *extracted* or separated, by appropriate methods, from those which are insoluble. The principal modes of extraction employed in pharmacy at present are as follows: 1. Maceration and expression. 2. Percolation. 3. Digestion. 4. Infusion. 5. Decoction. Maceration and expression are old processes, and they will be considered first; percolation is much more important and useful, and will be treated of in a separate chapter; digestion is merely a modified form of maceration. Infusion and decoction are processes which are used in producing separate classes of official preparations. Hence they will be considered in Part II.

Maceration

The process of *maceration*, which is of ancient origin, consists simply in soaking the properly comminuted drug or substance in the menstruum until it is thoroughly penetrated and the soluble portions softened and dissolved. The usual method is to introduce the drug or substance into a bottle with the menstruum, cork it tightly, and agitate it occasionally for a period ranging from two to fourteen days; then to pour off the liquid, express the residue to avoid waste, and filter the mixed liquids. An advantage is sometimes gained by suspending the ground drug, tied in a bag, in the upper part of the menstruum (see Fig. 373). This is sometimes termed *circulatory maceration*. Maceration is the process directed by the German Pharmacopœia in preparing tinctures. The drugs are ordered in all cases to be macerated in definite weights of alcohol for a week in a closed bottle, in a shady place, with frequent agitation, at a temperature of about 15° C. The liquid is then separated by straining or expressing from the insoluble residue, and, after having been allowed to settle, it is filtered. Evaporation during filtration is to be avoided as much as possible. Maceration has no advantages over percolation in making the greater number of

FIG. 373



Circulatory maceration

liquid preparations from drugs, except in the hands of the careless or unskilful. If an operator possesses no knowledge whatever of the process of percolation, it is safer to trust to maceration, for here no particular skill or judgment is necessary; the soaking process is completed in due time, and the separation of the absorbed liquid, while laborious and uncleanly, has at least the merit of leaving the tincture uniform in strength; if the process of expression is not thoroughly performed, pecuniary loss results, but the finished preparation is uniform. On the other hand, in percolation, if the operator has, through careless packing, failed to exhaust thoroughly the drug with the amount of menstruum used, a portion of the activity of the drug remains in the residue, which is thrown out, and the preparation is thus deficient in strength. In making tinctures by maceration, the practice of weighing liquids, as directed in the German Pharmacopœia, is seen to the best advantage, although, of course, the principal objection to preparations made from weighed liquids still exists,—the necessity for a calculation to determine the dose as compared with that of the drug. The tincture must always be administered by measure, and hence a teaspoonful or a fluidrachm should bear a certain relation to the drug, which is readily ascertained without resorting to a problem in specific gravity.

Digestion is that form of maceration which consists in the application of a gentle heat to the substance which is being treated. It is used in those cases where a moderately elevated temperature is unobjectionable, the heat increasing the solvent powers of the menstruum.

QUESTIONS ON EXTRACTION

What is meant by extraction? (See page 269.)
What is meant by menstruum?
What are the principal modes of extraction employed in pharmacy?
What is meant by maceration?
What is meant by circulatory displacement?
How are all tinctures directed to be prepared by the German Pharmacopœia?
Which is the better process in unskilled hands, maceration or percolation, and why?
What is the principal objection to preparations made from weighed instead of measured liquids?
Define digestion.

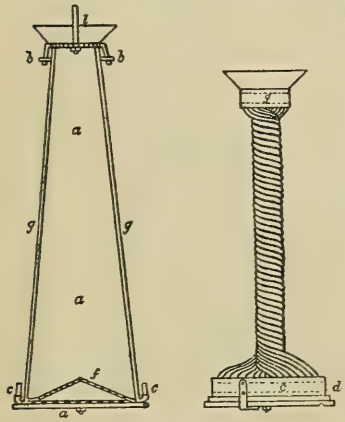
CHAPTER XIX

EXPRESSION

EXPRESSION is the process of *forcibly* separating liquids from solids. It is generally effected by the use of a press, although for many pharmaceutical operations, upon the small scale, the use of straining cloths with hand pressure suffices. Pressing cloths are generally employed but they are troublesome, and of late years strong efforts have been made to construct presses which could be used without them. At least six mechanical principles are recognized in the operation of expression as now practised : namely, by the use of—1. The spiral twist press. 2. The screw press. 3. The roller press. 4. The wedge press. 5. The lever press. 6. The hydraulic press.

1. **The Spiral Twist Press.**—The principle of this press is best and most practically illustrated in the usual process of expressing a substance contained in a cloth with the hands. The mixture to be expressed is placed in a bag or a cloth held in one hand by the four corners, which are gathered together, and the lower portion, or bag, is rotated with the other hand, so that, beginning at the top, the point of smallest diameter, the strainer is spirally twisted, the pressure forcing the liquid between the meshes of the cloth. Figs. 374 and 375 show Gigot's press, in which this principle is used upon a larger scale. Upon the left hand is shown a sectional view of the press as it appears when filled with material. The perforated cone, *f*, forms the bottom of a conical strong cloth tube ; the upper end is connected with a funnel, *l*, which is so constructed that none of the material that has passed down into the bag can leak back. The lower portion of the cloth is secured to a ring, which may be fastened, so that it will not rotate when the press is used. If the upper end of the cloth is twisted, the space occupied by the material is contracted, and the liquid oozes through the meshes of the cloth. The dry residue is discharged by untwisting the cloth and unhinging the bottom, which opens downward.

FIG. 374 FIG. 375



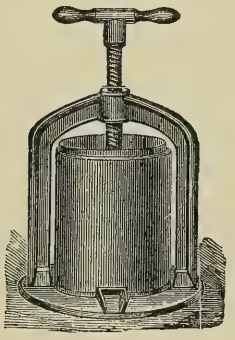
Gigot's press

2. **The Screw Press** is the most useful of all forms for pharmaceutical work where very great power is not desired. The screw is always used in combination with one or more levers, and this form of press is employed in great variety to accomplish special purposes. There are two forms of screw presses : 1. Single screw presses. 2.

Double screw presses. Each of these forms may be subdivided into those in which the position of the screw or screws is *vertical*, and those in which the position of the screw or screws is *horizontal*.

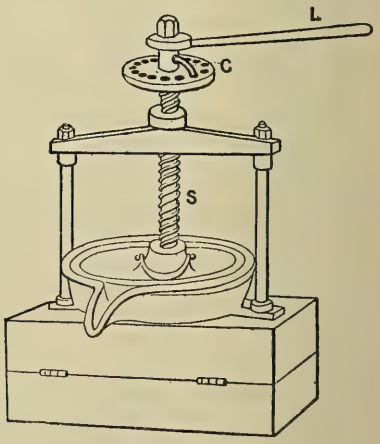
Single Screw Presses.—In this form of press the single screw is generally used in a vertical position, and operated with a lever or a combination of levers. It is the simplest kind of press, and if well made will admirably answer the general purposes of the pharmacist. The screw should have a square faced thread, and be well made. The plunger should be disconnected from the end of the screw, or else move freely around it. The parts of the press which come in direct contact with the material to be pressed should be coated with tin or porcelain, so that liquids containing acid or tannin shall not be affected injuriously. Fig. 376 shows a press of this description, made by H. Troemner, of Philadelphia. A perforated tin case accompanies the press. This may be used when pressing bulky drugs, like arnica flowers, and press cloths may be abandoned. The best material for press cloths is that which is especially made for the purpose. It is twilled and elastic in one direction, and, if proper care be taken when enveloping the material and introducing it into the press, the same cloth may be used many times, as the pressure causes the meshes to open without breaking the threads. The manufacturers of linseed oil use press cloth largely. For small operations, in the absence of press cloth, which is very expensive, new Russia crash may be used. The press cloth should be moistened, if possible, with some of the same liquid expressed at a previous operation.

Fig. 376



Troemner's press

Fig. 378

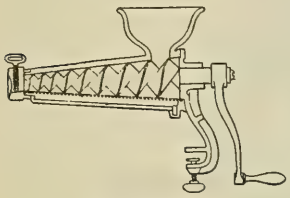


German single screw press

Water answers very well if the liquid is aqueous. The substance to be pressed is laid upon cloth and one corner of the cloth laid over it. The opposite corner is then placed upon the first; next one of the remaining corners is laid in the same way upon the first two, followed by its opposite. The corners should be folded over so that a square, somewhat flat package is produced, in size somewhat smaller than the press plate, especial care being observed to suit the quantity of material to the capacity of the press. If too much is taken, the

press cloth will be too small to permit of folding it over sufficiently; the corners of the package will therefore not withstand the pressure, portions of the material itself will ooze out, and the whole operation must be repeated. The principal objection to the single screw press is, that unless the material in the press is nearly homogeneous, so that the press cake is equally pressed upon at all points, unequal action results, the press block is pressed against one side of the case, causing violent friction and resistance, and the thread of the screw binds upon one side, full pressure thus being defeated; while the main objection to the vertical screw is that the press block and plate must be in a horizontal position, so that the liquid pressed out adheres to the cloth, and cannot be collected readily without tilting the press. Fig. 378 is an illustration of a German single screw press which is well adapted to pressing the residues from macerated tinctures. The large lip of the containing vessel is a practical convenience, while the lever, L, in combination with the catch, C, gives unusual power and ease in working, for a small press. In the horizontal screw press, the jaws being vertical, there can be no obstruction to the dropping of the expressed liquid, which may be caught in a vessel placed immediately under it. Oberdoffer, of Hamburg, Germany, makes a very powerful horizontal screw and compound lever press. Fig. 379 illustrates a horizontal screw press, made by the Enterprise Manufacturing Company, of Philadelphia, which is operated without a press cloth. It consists essentially of a tapering cylinder, with a hopper on the upper side at its large end, and a strong screw fitting closely to the inner surface of the case, the thread of which diminishes in size as the screw becomes smaller. Along the under side of the cylinder is formed a channel adapted to receive a perforated brass plate. This latter has a transverse concavity corresponding to that of the inner surface of the cylinder, and the perforations allow the escape of the expressed fluids into the channel or gutter beneath, from which it escapes by a proper outlet. The substance to be expressed is placed in the hopper, and, the crank attached to the screw being turned in the proper direction, the thread of the screw compresses the substance into a smaller and smaller space, until finally it is discharged at the farther end of the cylinder in a comparatively dry state. A large screw, passing through a removable end of the conical cylinder, regulates the size of the outlet, and serves to increase or diminish the amount of pressure to which the mass is subjected by the screw. The brass plate in the bottom of the machine can be replaced by others having perforations of different sizes. Clogging of the holes by bits of wood, stems, or seeds is prevented by the shear-like action of the edge of the screw thread, which shaves off the protruding fragment, while the rest is forced through the perforation. To increase the power of the press upon slippery substances, the inside of the casing has a few longitudinal or spiral grooves at a greater or less angle to the direction of the screw thread. Arrangements are provided for detaching the casing from the screw, and for attaching

Fig. 379

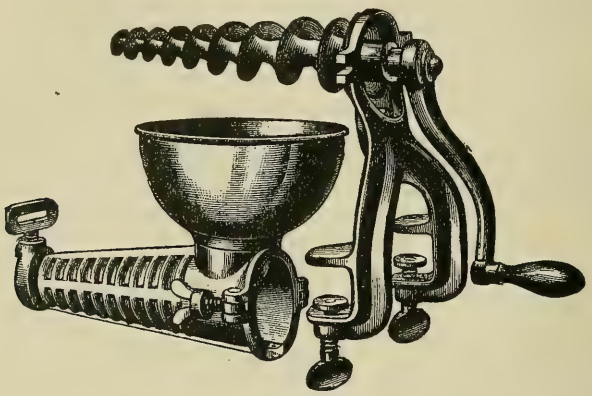


Enterprise press

the whole to the edge of a table or bench. Fig. 380 shows the press as taken apart.

Double screw presses are preferred by many. These are always of the horizontal screw form, and in Fig. 381 is shown one made as proposed by Chas. T. George, of Harrisburg, Pa. A strong and sub-

Fig. 380

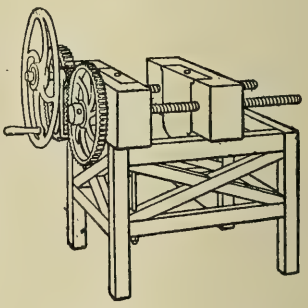


Enterprise press

stantial framework, made of ash wood, forms the base. Two pieces of timber rest upon this frame, one firmly attached by an iron rod and keepers to one end of the frame or table, and the other free or movable, both blocks being bored at the same distance from the end with smooth holes to receive the two iron screws.

Upon the movable block, and opposite the holes, a female nut of bell metal is firmly fixed. Upon the inner face of the two timber blocks, iron castings, saddle shaped and hollow, are inserted, flush with the face of the block, each capable of holding six pints of boiling water, and each casting having a hole on top to receive hot water or steam. A brass petcock is fixed at the bottom to discharge the chilled water.

Fig. 381



George's double screw press

The two iron screws pass through the holes of both blocks of timber, the head of each screw having an iron cogwheel attached to it; into the cogs of each wheel a pinion wheel is firmly fixed, which in turn is fastened to a short shaft having at its end an iron flywheel.

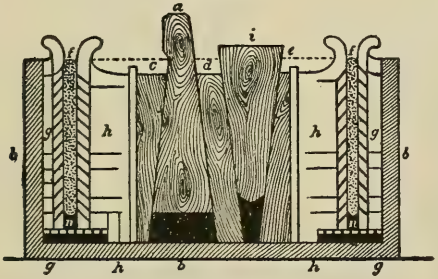
By turning this wheel both screws are evenly and rapidly rotated without danger of bending or breaking, and consequently one block is drawn surely and with great power against the other, thus expressing whatever drug may be placed in a sack of strong linen towelling between the two blocks of timber.

It is apparent that the double screw press is very powerful, and, the pressure being equalized, good results are obtained.

3. **The Roller Press** is used upon the large scale for pressing oily seeds, fatty substances, etc. Its principle is thoroughly shown in the well known clothes wringer, which, although made for the laundry, serves as a very efficient press for many substances. Care must be taken to apply the force gradually to the bag containing the berries or other material to be pressed, and not to use it upon substances which will soften or dissolve the rubber rollers.

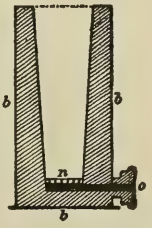
4. **The Wedge Press.**—This form of press is powerful, economical, and inexpensive. It is objectionable principally on account of the noise necessarily made in driving the wedges. Fig. 382, taken from Knapp's Technology, illustrates the wedge press. The filled cloths are laid between strong plates, *h* and *g*, and placed in a square space cut in a solid block of oak wood or in a cast iron case, *b*, and the plates are forced nearer and nearer to each other by driving in the wooden wedges which occupy the remaining space. One of these wedges, *a*, serves to facilitate the disconnection of the apparatus, the strokes which drive in the wedge *i* tending, from the reverse position of *a*, to drive the latter out; *c*, *e*, and *d* are intermediate pieces to prevent the wedges from coming into immediate contact. The pressing plates are each provided with three side ribs. The immovable ones, *g*, *g*, press against the sides of the case, and the movable ones, *h*, *h*, against the intermediate wedges, *c*, *e*, and are pierced with numerous holes to allow the liquid to flow out more easily. On filling the press, the wedge *a* must be suspended (by a string) at a distance from the bottom, so that the apparatus may be easily taken to pieces. The liquid trickles from the pressing plates through the pierced hori-

Fig. 382



Wedge press

Fig. 383



Wedge press (end view)

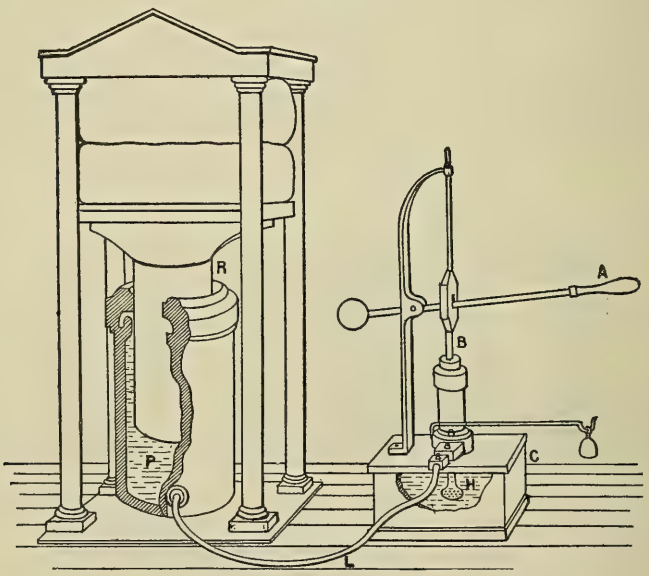
zontal plates, *n*, *n*, upon which these rest, into the pipe *o*. Both *a* and *i* are driven by separate stampers, which are raised by a toothed wheel, or mallets may be used.

5. **The Lever Press.**—The only advantages possessed by this press over those previously noticed are its cheapness, and that it may be made by any one possessed of even moderate mechanical abilities. Prof. Procter recommended the following method of construction. "A piece of timber twelve feet long, and with lateral dimensions sufficiently great to be inflexible with the force to be applied to it, has one of its ends securely attached to a wall or upright post in such a manner as to admit of the motion of the other end. The pressing

box being placed about one foot from the fixed end, on a firm block of wood, is subjected to the action of the lever by placing a piece of wood vertically between the piston block of the pressing box and the lever. It is obvious that a weight of one hundred pounds at the opposite end causes a downward pressure equal to eleven hundred pounds at the box. The pressing box most usually employed is a cylinder, closed at one end, made of thick tinned iron, secured with bands of the same material, which are soldered on, and between these, numerous holes are perforated. This cylinder is set in a tin dish with a lateral spout. The piston block is constructed of hard oak wood with the grain running transversely to its axis." The objection to this press is that, compared with other presses, it yields but little power in proportion to the space occupied; but as an offset to this it can be made to work simply and quickly.

6. **The Hydrostatic or Hydraulic Press.**—Of the presses heretofore mentioned, each has some especial advantage or use, but each has also some fault or objectionable feature. The spiral twist is not powerful, and its action is limited. The screw presses of both varieties have friction to contend with. The friction of a screw increases

Fig. 384



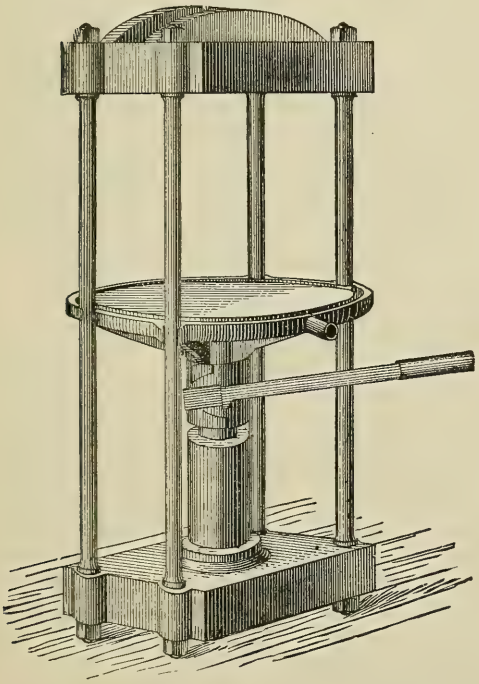
Hydraulic press

with the intensity of the pressure applied, and when a certain limit is reached all further force applied is wasted, and, if persisted in, involves the destruction of the press. The roller press is very limited in its action; the lever press is unwieldy and not powerful; the wedge press is noisy and can be used only for special purposes. The hydrostatic press is costly, but after the first cost it is the most economical, because the greatest power is obtained at the expense of

the least labor. The principle is shown in Fig. 384. It must be remembered that the molecules of fluids move freely in contact with one another almost without friction, and, according to Pascal's law, "Pressure exerted anywhere upon a mass of liquid is transmitted undiminished in all directions, and acts with the same force on all equal surfaces and in a direction at right angles to those surfaces."

Although it has been proved that liquids are to a slight extent compressible, it has also been shown that they are *perfectly elastic;* so that if a plug be forced into a liquid which entirely fills the vessel, the pressure is felt equally upon every square inch of the surface of the vessel and upon every square inch of the surface of any body immersed in the liquid, and if the pressure is removed from the plug it will be immediately forced out of the vessel and the liquid will at once regain its original volume. Now, if a vessel is constructed having two columns communicating at the bottom, as in Fig. 384, and if water or other fluid is placed in it, it will be found that a pressure of one pound applied at the piston in the tube, B, will be communicated to every portion of the lower surface of the ram, R. If the area of R is ten times greater than that of B, it follows that a pressure of one hundred pounds on A, conveyed through the lever, exerts an upward pressure of one thousand pounds on R. By increasing the area of the ram the power may be greatly multiplied, so that pressure applied by one man on the lever may be communicated to the liquid and made to exert an upward pressure of several tons. Fig. 385 shows a pharmaceutical press made by R. Dudgeon, of New York, constructed on the principle of hydrostatic pressure. In order to economize space, by an ingenious system of valves one of the cylinders is contained within the other, and by pumping the oil into the outer vessel the ram carrying the platen is forced upward. The platen has a groove around its edge communicating with a spout for carrying off the expressed liquid. Press cloths may be used to contain the material to be pressed, or a very strong perforated case is supplied. The upper plate is very strongly secured by bolts and nuts, and press blocks covered with tinned iron are employed to fit into the perforated case if desired. The weight of one man, one hun-

Fig. 385



Dudgeon's press

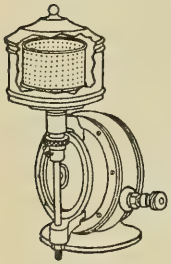
dred and fifty pounds, applied to the end of the lever will produce an upward pressure equivalent to ten tons. This is the most powerful press available for pharmaceutical purposes, and, although expensive, its first cost will be more than offset by its durability and by its economy of power whenever pressure greater than that afforded by the smaller presses is needed.

The following maxims should be observed in operating presses:

1. All moving parts of the press should be well lubricated before attempting expression.

2. Pressure should be *gradually* increased; sudden strains should always be avoided. If this precaution is neglected, either the press cloth or press bag will burst, the finer solid particles will be forced through the meshes, or breakage of press plates or press will result.

Fig. 386



Centrifuge (under driven)

Fig. 387

Centrifuge (over driven)

3. Pressure, to secure the best results, should be unrelaxed, but intermittent. After apparently reaching the limit of compression, the action of the press should cease, and if the pressure be maintained unrelaxed it will be found that in a short time further pressure may be applied and more liquid separated. In this way, by alternately exerting pressure and resting, the utmost limit of the power of the press may be gradually reached without undue strain. Screw presses have more ability to retain pressure than hydraulic presses; the valves of the latter frequently leak slightly, and the pressure has to be continually renewed.

Centrifugal Machines or Centrifuges.—For separating liquids from solids the principle of centrifugal motion has been successfully used. The machine consists of a central, perforated cylindrical cage surrounded by a case; the cage is attached to a vertical shaft, which is capable of being speeded to several thousand revolutions a minute. The wet material is placed in the cage, the machine started, and the liquid forced by the rapid motion through the perforations into the space between the outer case and the cage. Figs. 386 and 387 show two kinds of centrifuges, Fig. 386 illustrating the "under driven" type, which is run by water power, and Fig. 387 showing the "over driven" type. Centrifuges are also made in larger sizes, driven by steam or by electric motors.

QUESTIONS ON EXPRESSION

What is expression? (See page 271.)
How many mechanical principles are recognized in the operation of expression, and what are they?
What is the principle of the spiral twist press?
What press is most useful in pharmaceutical operations where very great power is not desired?
How many forms of screw presses are there?
Describe a single screw press.
What is the best material for press cloths?
What is the principal objection to the screw press?
Describe the Enterprise Co.'s horizontal screw press.
Describe the double screw press as proposed by Mr. Charles T. George.
What is the principle of the roller press?
Describe the wedge press.
What objection is there to it?
Describe the lever press.
What are its advantages?
What is an objection to it?
What is the principal of hydrostatic or hydraulic press?
What are its special advantages?
In operating presses, what maxims should be observed?
Which can retain pressure most effectually, screw presses or hydraulic presses and why?
Describe a centrifugal machine or "centrifuge." Upon what principle does it operate?

CHAPTER XX

PERCOLATION

Percolation, or Displacement, is the process whereby a powder contained in a suitable vessel is deprived of its soluble constituents by the descent of a solvent through it. The importance of this process cannot be overestimated, as the progress made in pharmacy in America during the last century is largely due to the study and development of percolation, and the introduction of preparations which are the direct outgrowth of the process.

History.—The practice of exhausting wood ashes of their soluble constituents by pouring water upon them after their introduction into a conical shaped wooden vessel called a lye hopper is an ancient one, and the process is still practised and known as *lixiviation*. The first attempt on record to apply the principle to powdered drugs was made by Count Real, who about the year 1815 invented a press which consisted of a metallic cylinder with a stopcock in the bottom and containing a perforated diaphragm for supporting the substance, and with a tight cover at the top, to which was attached an upright tube, ten or twelve feet high, having a funnel soldered to its upper extremity. The cylinder was packed with the coarsely ground drug, and water poured into the tube. The pressure of the column of water was so great, however, that the principal difficulty in using the apparatus was in securing tight joints, and in preventing the incomplete exhaustion of the drug on account of the too rapid passage of the water through it. M. Robiquet subsequently made some experiments to determine the power of ether as a solvent in extracting the fixed oil from the bitter almond. He observed that ether poured on powdered bitter almond displaced the fixed oil without mixing materially with it, and he published his observation. It was reserved, however, for the Boullay brothers, of Paris, in 1833, to apply the ideas of Real and Robiquet to drugs and medicinal substances in general, and to them belongs the credit of first demonstrating the value of the process of percolation in its pharmaceutical applications. The researches of the Boullays at once attracted the attention of American pharmacists, and the labors of Duhamel, Procter, Grahame, Squibb, and others during the last century, and the adoption of the process in the Pharmacopœias of 1840, 1850, 1860, 1870, 1880, 1890, and in the 8th Revision, sufficiently show the character of the growth in favor of percolation. In Great Britain, France, and Germany the process is well known, and is practised to some extent, but maceration still holds in these countries the chief place as a means of extracting the soluble principles of drugs.

Principle of Action.—*When a powder placed in a cylindrical vessel with a porous diaphragm below, is treated from above with a liquid capable of dissolving a portion of its substance, that portion of the fluid first in*

contact, in passing downward, exercises its solvent power on the successive layers of the powder until saturated, and is impelled downward by the combined force of its own gravity and that of the column of liquid above it, minus the capillary force with which the powder tends to retain it. If the quantity of liquid added is not more than enough to satisfy the capillarity of the powder, no liquid will pass the diaphragm; but the careful addition of liquid upon the top displaces that absorbed in the powder without mixing materially with it, and takes its place, to be in turn displaced by a fresh portion of liquid. The instrument used to hold the powder is called a *percolator;* the liquid poured on top of the powder, the *menstruum;* the liquid coming from the percolator impregnated with the soluble principles, the *percolate.* In order thoroughly to understand the process of percolation as applied to powdered drugs, it must be remembered that the soluble principles of vegetable substances are in a hard and dry condition, and are generally contained in cells which are more or less disintegrated by the process of grinding. If the soluble principles could be perfectly separated from the insoluble cellular substance by any means, and be deposited in the interstices of the ground particles, percolation would indeed be a rapid process, for the descending column of liquid would immediately dissolve the soluble principles, which would be found in the receiving vessel, while the insoluble substances would remain in the percolator, and the separation would then be easily accomplished. But the powdering of the drug only partially separates the soluble principles from the insoluble, and the finest dust of the powder always contains a larger proportion of the soluble principles than of the insoluble substance, because the latter, often being largely ligneous, offers the greatest amount of resistance to disintegration. Hence the first portion of the percolate is always the most dense, the most highly colored, and contains the largest proportion of the soluble principles, because the first portion of menstruum, in its descent through the powder, has the first opportunity to come in contact with the largest proportion of the soluble principles, which are to be found in the finer dust scattered through the powder, and in the thoroughly disintegrated particles, which offer but slight resistance to the passage of the menstruum. In every well conducted experiment in percolation it will be noticed that, as the operation proceeds, each succeeding portion of percolate is less highly colored and less active than the one preceding it; and in the case of drugs containing easily dissolved coloring matter, an examination of the percolate will show that the shading is very marked, the lowest portion being very dense and dark colored, the upper portion almost colorless, while in the intermediate liquid the gradations of the tint are clearly perceptible.

The directions of the United States Pharmacopœia upon percolation are as follows:

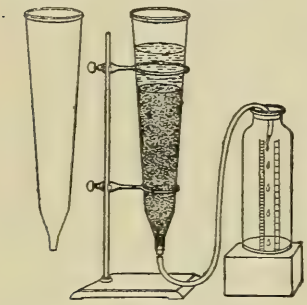
"*Percolation*, as directed in this Pharmacopœia, consists in subjecting a comminuted substance or a mixture of substances, contained in a vessel called a percolator, to the solvent action of successive portions of a liquid termed the menstruum in such a manner that the liquid, as it traverses the powder in its descent to the receiver, shall extract the soluble constituents, and pass from the percolator free from insoluble matter.

"When the process is successfully conducted, the first portion of the liquid, or percolate, passing through the percolator will be nearly saturated with the soluble constituents of the substance treated; and if the quantity of menstruum be sufficient for its exhaustion, the last portion of the percolate will be nearly free from color, odor, and taste, other than those of the menstruum itself.

"In preparations which direct the process of percolation, wherever the expression 'until the drug is exhausted' or a similar phrase occurs, it is to be understood that the term 'exhausted' means the point at which the valuable constituents have been as completely extracted as is possible or practical, and this must be determined by the judgment and experience of the operator.

"*Percolators.*—The following statement with regard to percolators and the process of percolation is given in order to illustrate a method of percolation. It is not intended as compulsory and it is permissible for manufacturers and others to modify the process to suit their needs. The percolator most suitable for the quantities contemplated by this Pharmacopœia should be nearly cylindrical, or slightly conical, with a funnel-shaped termination at the smaller end. The neck of this funnel-end should be rather short, and should gradually and regularly become wider toward the orifice, so that a perforated cork, bearing a short glass tube, may be tightly wedged into it. The glass tube, which must not project above the inner surface of the cork, should extend from 3 to 4 cm. beyond the outer surface of the cork, and should be provided with a closely fitting rubber tube, at least one-fourth longer than the percolator itself, and ending in another short glass tube, whereby (when it is desired to interrupt the percolation) the rubber tube may be so suspended that its orifice shall be above the surface of the menstruum in the percolator, a rubber band holding the tube in position.

FIG. 388 FIG. 389



Official percolator Official percolation

"The shape of a percolator should be adapted to the nature of the drug to be operated upon. For drugs which are apt to swell, particularly when a feebly alcoholic or an aqueous menstruum is employed, a *conical* percolator is preferable. A *cylindrical* or only slightly tapering percolator may be used for drugs which are not liable to swell, particularly if difficult to exhaust, also when the menstruum is strongly alcoholic, or when ether or some other volatile liquid is used for extraction. The size of the percolator selected should be in proportion to the quantity of drug extracted. When properly packed in the percolator, the drug should not occupy more than two-thirds of its height. The percolator is best constructed of glass, but, unless otherwise directed may be made of any suitable material not affected by the drug or menstruum. For hot percolation glass percolators are unsuited, as they are liable to fracture. Metallic percolators in such cases are required

"The percolator is prepared for percolation by gently pressing a small tuft of purified cotton into the neck, and this may then be moistened

by pouring a few drops of menstruum upon the cotton, to facilitate the passage of the first portion of percolate, which is often very dense.

"*The Process.*—The powdered substance to be percolated (which should be uniformly of the fineness directed in the formula, and should be perfectly air-dry before it is weighed) is put into a suitable dish, sufficient menstruum is poured on, and the powder thoroughly stirred until it is uniformly moistened. The moist powder is then passed through a coarse sieve—No. 40 powders, and those which are finer, requiring a No. 20 sieve, and No. 30 powders require a No. 15 sieve for this purpose. Powders of a less degree of fineness usually do not require this additional treatment after the moistening. The moist powder is now transferred to a sheet of thick paper and the whole quantity poured from this into the percolator. It is then shaken down lightly and allowed to remain in that condition for a period varying from fifteen minutes to several hours, unless otherwise directed; after which the powder is pressed, by the aid of a plunger of suitable dimensions, more or less firmly, in proportion to the character of the powdered substance and the alcoholic strength of the menstruum, strongly alcoholic menstrua, as a rule, permitting firmer packing of the powder than the weaker. The percolator is now placed in position for percolation, and, the rubber tube having been fastened at a suitable height, the surface of the powder is covered by an accurately fitting disk of filtering paper, held in place by a glass stopper or percolator weight, and a sufficient quantity of the menstruum poured on through a funnel reaching nearly to the surface of the paper. If these conditions are accurately observed, the menstruum will penetrate the powder equally until it has passed into the rubber tube and has reached, in this, a height corresponding to its level in the percolator, which is now closely covered to prevent evaporation. The apparatus is then allowed to stand at rest for the time for maceration specified in the formula.

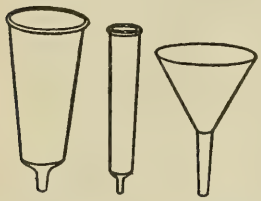
"To begin percolation, the rubber tube is lowered and its glass end introduced into the neck of a bottle previously marked for a quantity of liquid to be received, if the percolate is to be measured, or of a tared bottle, if the percolate is to be weighed; and by raising or lowering this receiver the rapidity of percolation may be increased or decreased as may be desirable. A layer of menstruum must constantly be maintained above the powder, so as to prevent the access of air to its interstices, until all has been added, or the requisite quantity of percolate has been obtained. This is conveniently accomplished, if the space above the powder will admit of it, by inverting a bottle containing the entire quantity of menstruum over the percolator in such a manner that its mouth may dip beneath the surface of the liquid, the bottle being of such shape that its shoulder will serve as a cover for the percolator.

"Unless otherwise directed, when the dregs of a tincture, or of a similar preparation, are to be subjected to percolation, after maceration with all or with the greater portion of the menstruum, the liquid portions should be drained off as completely as possible, the solid portion packed in a percolator, as before described, and the liquid poured on, until all has passed from the surface, when immediately a sufficient quantity of the directed menstruum should be poured on to displace the retained liquid, until the prescribed quantity has been obtained.

" *Repercolation or Fractional Percolation.*—Type Process C for fluidextracts (see page 524) represents this process and it may be used to replace the usual percolation methods, if the original menstruum is not changed.

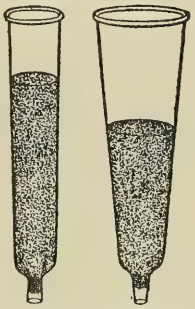
" *Maceration.*—Percolation is not suitable for exhausting some drugs, and the process of maceration is employed for some of the tinctures

FIG. 390 FIG. 391 FIG. 392



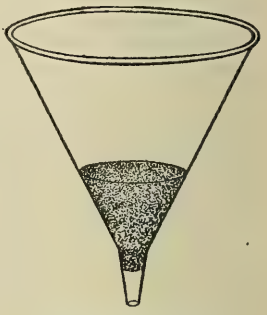
Plain percolator Oldberg's percolator Conical percolator

FIG. 393 FIG. 394



Narrow percolator (200 Gm. of powder) Ordinary percolator (200 Gm. of powder)

FIG. 395



Conical percolator (200 Gm. of powder)

(Aloes, Asafetida, Tolu, etc.). Specific directions will be found in the text, and maceration should be conducted preferably at a temperature of from 15° to 20° C. (59° to 68° F.)."

Shape of the Percolator.—In the U. S. P. 1880 the shape and size of the cylindrical percolator preferred for pharmacopœial operations were definitely fixed (see Fig. 388). There can be no question that the glass cylindrical percolators (see Fig. 390) commonly furnished by the manufacturers are proportionally too broad for use in percolating drugs for fluidextracts where the quantity of drug is large in proportion to the quantity of menstruum; but for ordinary tinctures, where the conditions are reversed, they answer admirably. The inference then is obvious, the pharmacist should have percolators not only of different sizes, but also of different shapes. Fig. 391 shows the narrow percolator recommended by Prof. Oldberg. It is narrower than the cylindrical percolator directed by the U. S. P. (9th Rev.). The studies on percolation during the last half century have been directed toward simplifying the process, and the elaborate apparatus of Count Real and others has been replaced by the ordinary percolator and funnel. The conical percolator of the Pharmacopœia is understood to be a glass funnel (see Fig. 392).

Judgment is required in selecting a percolator for an operation. In making a fluidextract a comparatively narrow percolator should be chosen, because it is desirable that the menstruum should traverse a higher column of powder, for every drop of the menstruum must be economically applied. The rate of flow of the percolator is thereby proportionally diminished, the percolate becomes saturated more rapidly, and thus the operation is more easily controlled, provided the limit has not been exceeded. *The character of the drug influences the limit.* For instance, one which contains a large quantity of soluble matter, like kino, could not be successfully percolated in a narrow percolator, because the percolate would soon become so dense that it

would cease to descend. In making tinctures and weaker preparations, a wider percolator is to be preferred, because the quantity of menstruum is greatly in excess of the quantity necessary to exhaust the drug, and more rapid action is desirable. Figs. 393, 394, and 395 show three percolators of the same height, but of very different shapes. Exactly the same weight of powder is represented in each. The great difference in the height of the columns of powder will be readily noticed, and illustrates the necessity for judgment in selecting percolators. If a fluidextract from the drug is to be made, the tall percolator, Fig. 393, should be selected; if a strong tincture, Fig. 394 indicates the shape; while for a weak tincture, the funnel shown in Fig. 395 would be preferred; it being understood that in each case the drug is not an exceptionally difficult one to percolate.

Comminution.—The degree of comminution proper for each substance must depend upon the physical structure of the drug, the ease with which the menstruum dissolves the active or desirable constituents, the length of time required to exhaust the powder, and the relative proportion of menstruum to drug. Nux vomica and ignatia are drugs having a tough, horny structure, in which the soluble constituents are embedded. If these drugs are to be quickly exhausted of their soluble principles, they must be in fine powder. On the other hand, gentian and rhubarb are drugs which part easily with their active constituents, because their structure is loose and quickly penetrated by the menstruum. Therefore these may be readily exhausted when in coarse powder. The relative proportion of menstruum to drug also has a bearing in determining the fineness of the powder, for it is clear that if a fluidextract is to be made in which one hundred volumes shall represent *one hundred* parts by weight of the drug, the powder should be a finer one than would be required for a tincture where one hundred volumes are used to exhaust *ten* parts by weight of the drug. In all cases, whether coarse or fine powder is directed, the powder should be *uniformly divided;* and the U. S. P. requires that in a powdered drug of any specified number the larger proportion must not pass through a sieve of a lower degree of fineness. The object of this is to permit the uniform descent of the liquid, for fine particles offer more resistance to the passage of the menstruum than coarse ones; and if the powder is not uniform, and the finer particles are deposited upon one side of the percolator, imperfect exhaustion may occur, through the passage of the greater portion of the menstruum upon the side of least resistance—*i.e.*, through the coarser particles.

FIG. 396

Pan for moistening powders

Moistening of the Powder.—The general rule in percolation is to moisten the powder, and there are very few instances in the official processes where it is not directed. The object of moistening the powder is very apparent. If a perfectly dry sponge is held in the hand and a gentle stream of water poured upon it, it will be noticed that very little water is absorbed by it; but if the sponge is thoroughly soaked, and all the water squeezed out that possibly can be, it will be found that it will greedily absorb water. Most drugs are vegetable substances which in their natural state were moist. The process of

desiccation has hardened and dried the tissues, so that, like the sponges they do not absorb moisture quickly, and when compressed, as they are when packed in a percolator, the resistance is still greater. If a dry powder, like ground orange peel, is tightly packed in a glass percolator and water poured upon it, it will be noticed that the water will penetrate the powder but a short distance. Its further passage is prevented by the particles which are immediately in contact with the water, which have become swollen to such a degree that they press tightly against the sides of the percolator, and thus entirely overcome the gravitating force and penetrating power of the water. If, on the other hand, the powdered orange peel is moistened *with sufficient water to satisfy its tendency to swell, before it is packed* in the percolator, the addition of water is followed by its slow percolation through the mass without stoppage, and the utility of moistening the powder is thus proved.

The special cases in which the powder should not be moistened are those in which the addition of menstruum would produce adhesiveness and cause the powder to form lumps that could not be easily penetrated, those in which the moistened powder would offer too little resistance to the passage of the menstruum, and those in which the menstruum is too volatile or too inflammable to render moistening desirable or safe. An instance of the first case is found in the so-called cold percolation of sugar in making syrups; instances of the second and third cases, in the preparation of the oleoresins where ether is used as the menstruum.

FIG. 397 FIG. 398

Notched cork

Scored paper

Packing the Powder.—The directions of the U. S. P. VIII with regard to this important part of the process of percolation varied continually. Where the degree of pressure was immaterial, no special directions were given. Where there was a likelihood of too much pressure being exerted, so that percolation would cease before it should, the directions were, "pack it moderately"; on the other hand, if there was danger of the operator allowing the menstruum to pass through too rapidly, so that the drug would not be exhausted of its active principles, the directions were, "pack it firmly." Owing to the introduction of Type Processes, the U. S. P. IX has omitted this valuable aid to the beginner and it is necessary for each operator to determine for himself the degree of pressure to apply in packing the drug. Before beginning to pack the powder, the throat of the funnel or of the percolator must be obstructed by a loose plug of absorbent cotton or a deeply notched cork (see Fig. 397), or by some other method. Care should be taken not to moisten the cotton or cork with water unless the menstruum is aqueous, because if the drug to be percolated is resinous, the first portions of percolate which come through will be precipitated by the water in the cotton or on the cork. Instances have occurred where the percolation has been stopped from this cause. Where the notched cork is used, it is well to place over the top of the cork, when it is in place, a small circle of scored filtering paper (see Fig. 398). This must be slightly larger in diameter than the cork, and the edges are therefore deflected up the sides.

The moistened powder should be carefully deposited in the percolator in layers, each succeeding layer being packed according to the requirements, "moderately" or "firmly," as the case may be, care being taken to use the same degree of pressure with each layer. Fig.

399 shows a convenient utensil for packing a percolator. It should be made of hard wood, preferably lignum vitæ; for the narrow percolators a longer packer must be used. The skill used in this part of the process will be proved by the manner in which the menstruum permeates the moistened powder. If the descent is regular and uniform, it is shown in a glass percolator by the line marking the descent of the menstruum being perfectly horizontal. If the line is irregular, it is easy to point out just where the pressure was insufficient or too great. Fig. 400 shows loose and irregular packing, too much pressure being made on the right side, the menstruum descending upon the left side unequally and escaping unsaturated. Fig. 401 illustrates a percolator which has been properly packed, the liquid descending uniformly.

Fig. 399

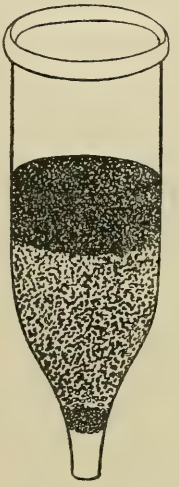
Packer

Adding the Menstruum.—When the last portion of moistened powder is introduced into the percolator, a sheet of filtering paper, scored at the edges and slightly larger in diameter than the surface of the powder, should be laid upon it, for the purpose of causing the even distribution of the menstruum. A weight of some kind is usually placed upon the paper, to keep it from floating out of place. Clean pebbles, a bottle stopper, or a small glass funnel may be used, but in Fig. 402 is shown a glass percolating weight, which has been made for this purpose by the Whitall Tatum Company. It is easily cleaned, is not readily broken, and does not take up much room. Where the percolator is large enough to hold the whole of the menstruum, it may be at once added carefully. When this is not the case, and the menstruum must be added in divided portions, care must be observed to follow with the succeeding portion before the first has entirely disappeared, or otherwise fissures may appear in the powder, and the menstruum will of course then seek the outlet offering the least obstruction, and will leak through the fissures instead of percolating through the powder. This is more apt to occur in percolating very fine powders than in percolating coarse ones, although liable to take place in either. Where a large quantity of menstruum is required, a contrivance for continually supplying the menstruum should be used, in the form of an inverted bottle or flask (see Fig. 269), or any of the methods for continuous washing may be employed.

Fig. 400

Imperfect packing

Fig. 401

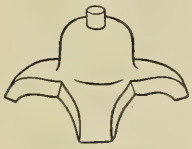


Proper packing

Previous Maceration.—This is recommended when the structure of the powder is tough, when the soluble principles are not easily extracted by the menstruum, or when a comparatively large quantity of

powder is to be exhausted by a small quantity of menstruum. It is obvious that maceration is going on constantly while the menstruum is traversing the powder during its gradual descent, and when the amount of menstruum is more than sufficient to exhaust the drug, previous maceration is merely a waste of time. Nevertheless, the framers of the Pharmacopœia, in order to prevent the possibility of an unskilful or ignorant operator failing to exhaust a drug with the quantity of menstruum directed, have adopted in most cases the precaution of ordering previous maceration for a short time. This is best performed by moistening the drug, introducing it loosely into the percolator, and covering it closely to prevent loss by evaporation. This course has the additional advantage of allowing the drug to swell at the same time.

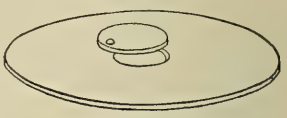
Fig. 402



Percolating weight

A cover made of sheet rubber (see Fig. 403), with a circular opening, is very useful in this connection. No attempt should ever be made to produce fluidextracts on the small scale without previous maceration.

Fig. 403



Sheet rubber cover

Finishing the Process.—The official directions are frequently definite in fixing the quantity of percolate to be received from a given quantity of powder, but the oft repeated direction to "add the menstruum until the substance is exhausted" at once raises the question, When is a drug exhausted of its activity? This question can be properly answered only by knowing beforehand what the active principles of the drug are. A few examples will sufficiently illustrate this. The activity of nux vomica, opium, and cinchona resides in the bitter alkaloids. Hence the *absence of bitterness* in the percolate in such cases indicates exhaustion. Cochineal and saffron are valued in pharmacy for nothing but the coloring matter contained in them. Hence the *absence of color* in the percolate shows the close of the process. Nutgall, kino, krameria, etc., contain tannin, and this is the only valuable principle. The *absence of astringency* in the percolate in these cases, therefore, shows the operator that percolation may be stopped. The exhaustion of resinous drugs may be known by the absence of precipitation when the percolate is dropped into water. Where two or more active principles exist in a drug, the latter is not exhausted until the percolate is free from all of them. *The intelligent practice of the process of percolation, therefore, requires an accurate knowledge of the constituents and physical properties of medicinal substances.*

Choice of Menstrua.—Much labor has been bestowed by investigators in ascertaining the exact proportions of the usual solvents—water, alcohol, glycerin, etc.—that are best adapted for depriving drugs of such of their soluble principles as are desirable, and at the same time leaving untouched in the residue those principles which are either inert or objectionable. The special menstruum which is exactly adapted to the peculiar characteristics of the drug, and which will cause the retention of the soluble principles in a permanent form under the varying conditions of climate, and at the same time permit exposure to light, heat, and air without injury, can be determined

only by experiment and experience. When new galenical preparations are proposed, the menstruum selected must therefore be merely tentative, and general principles must guide, until positive knowledge is secured. Alcohol would be indicated for active resinous drugs, diluted alcohol for simple bitter tonics, cathartics, etc., and diluted alcohol with glycerin for astringent drugs, etc. The selection of proper menstrua will be noticed, as occasion demands, in the chapters upon infusions, tinctures, extracts, fluidextracts, etc.

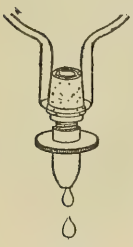
Absorbed Menstruum.—The amount of menstruum which a powder will absorb and retain after percolation ceases can never be accurately predetermined. If it is important to know beforehand the percentage of menstruum capable of being absorbed, a practical trial should be made upon the small scale, using the same powder and menstruum.

Substances possess very different capacities for retaining menstruum. Those having a light, spongy structure hold more than hard ligneous drugs, and even the same drug will often vary in its capacity in this respect while the amount of moisture present in the drug before it is percolated is never a constant quantity, varying sometimes as much as 8 to 20 per cent. The advantages of percolation over maceration are very apparent in respect to the character of the liquid left in the residue. In maceration the liquid left in the residue is finished tincture. In percolation it is merely menstruum, the active portions of the drug having been dissolved in the preceding percolate. In large operations, from an economical point of view, it is desirable to recover absorbed menstrua when the residues contain sufficient alcohol to make it worth the necessary time and labor. Distillation is then resorted to, or the residue is treated with weak alcohol and subsequently with water. Where water causes swelling of the substance and a stoppage of the percolation, the residue may be mixed with clean sawdust, rice chaff, or other inert dry substance, and then percolated with water. Recovered distilled alcohol may be purified by treating it with potassium permanganate ; twelve grains dissolved in a gallon of the percolate, and allowed to stand a few days, are usually sufficient. The purified alcohol may be decanted or filtered. Care must always be taken not to use unpurified recovered alcohol which is odorous on account of containing volatile oil obtained from a drug, or which may be otherwise impure.

Controlling the Flow of the Percolate.—The necessity for some method of controlling the flow of the percolate is apparent. In simple percolation this is effected by the degree of pressure used in packing the moistened drug. Judgment and experience are absolutely necessary to guide the operator. Various mechanical expedients have been used to accomplish the same purpose. The official method has been described (see Fig. 389). In metallic percolators stopcocks have been employed. A narrow homœopathic vial, having a one-eighth inch hole in the side, a half inch from the bottom, is passed through a perforated cork fitting tightly in the neck of the percolator ; by pulling the vial down, the hole is stopped by the encircling cork ; by pushing it up, the hole is exposed so that the percolate runs through the vial, and thus the flow may be controlled. Fig. 404 illustrates a method of controlling the flow of a percolate which has proved in the author's

experience very useful. The well known sprinkler, made of white metal, used for liquid dentifrice bottles was first tried, and subsequently the form shown in Fig. 404 was selected. It is made by A. H. Wirz, Chester, Pa. The flow of liquid can be perfectly controlled by its use. In the U. S. P. IX the following directions are found:

Fig. 404



Sprinkler controller

"Rate of Flow.—It is obvious that the success of the process of percolation largely depends upon the regulation of the flow of the percolate; if this should be too rapid, incomplete exhaustion will result, but if too slow, valuable time may be wasted. The rate of flow for fluidextracts for 1000 Gm. of powder should not exceed ten drops a minute; for official quantities of tinctures and preparations of about the same strength twenty drops a minute, and the word 'slowly' throughout the text is understood to mean a rate of flow corresponding to this; it is evident that the proper rate of flow should vary with the quantity and character of the drug employed and the density of the menstruum."

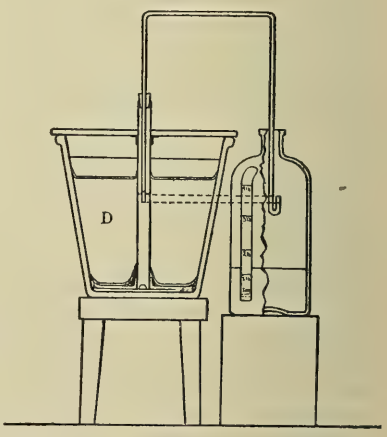
Special Percolators

Stoppered Percolator.—Many modifications in the ordinary cylindrical or conical percolator have been suggested from time to time to suit special requirements. In Fig. 405 is shown a glass percolator proposed by Dursse, the special merit of which lies in the manner in which evaporation is prevented. This is effected by means of the ground glass cover. The upper part of the percolator, R, is strengthened by a deep band; the glass cover, C, is carefully ground so as accurately to fit the percolator and make a nearly tight joint, which can be improved by moistening the edge with glycerin. If the percolate should flow too freely, it can generally be checked by screwing in the cover of the percolator; should it flow too slowly, a small piece of twine inserted between the cover and the side will permit the necessary pressure of the atmosphere. The graceful outlines of this percolator, and the evident care used in its manufacture, may be mentioned as points in its favor.

Fig. 405

Dursse's percolator

Fig. 406



Well tube percolator (Squibb)

Well Tube Percolator.—An excellent method of percolation which was used by Dr. E. R. Squibb for a number of years, and is still employed, is shown in Fig. 406. It is based upon the principle of drawing water from a well automatically as fast as it accumulates.

This is effected by the use of a well tube placed in the centre of an ordinary jar or pot and held in its place by the powdered drug which is packed around it. The menstruum is poured upon the drug, and, after percolating through, collects in the well tube, from which it is drawn off by an ingeniously constructed syphon. The practical value of this method warrants a detailed description. It may be used for either large or small operations.

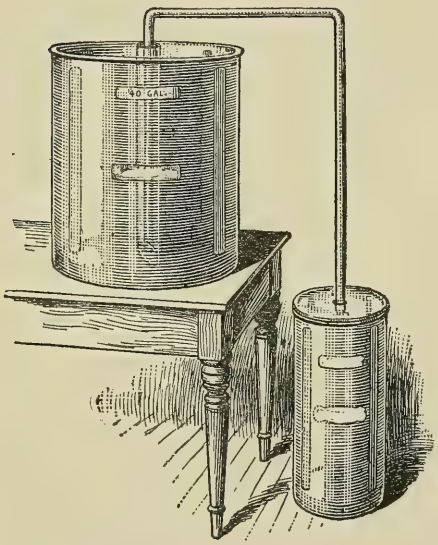
The percolator is a stoneware pot of about two gallons' capacity, capable of holding six pounds of most drugs, and mounted on a suitable stand. A disk of blanket is cut of such a size and shape as to lie flat upon the bottom and cover it entirely. Another disk, of the same material, but a little larger, is made with a crucial incision (X) in the centre, so that it may be stretched over the end of the well tube. This is a piece of glass tube about twelve inches long, having an internal diameter of half an inch, and irregularly notched or gnawed off obliquely at the lower end. One end of this well tube is pushed through the crucial cut in the centre of the upper disk of blanket, and this blanket is pushed to the other end of the tube, so that the corners made by the crucial cut are reflected up against the outside of the tube. These corners are then tied firmly to the tube by passing twine around them, or are secured by a stout rubber band, made of a section of rubber tubing of proper size. A disk of filtering paper, larger than the upper blanket, with a crucial cut in the centre, and scored round the edge so as to lie flat against the sides of the percolator where reflected up against them, is pushed down upon the upper blanket, the well tube passing through the cut in the centre. If now a cork be temporarily placed in the well tube to keep out the moistened powder, the percolator is ready to receive its charge, which is packed around the well tube and upon the disks of paper and blanket so as to occupy the main body of the percolator. When the charge, having been properly moistened, rubbed, and sifted, so as to be entirely uniform and free from wet lumps, is packed around the well tube loosely or firmly according to the nature of the substance and the menstruum, its surface is covered by a disk of muslin or paper, cut so as to lie flat and smoothly upon the surface. The object of this is to distribute the menstruum as it is poured on, and to prevent the stream from breaking up and deranging the surface. Should this paper disk show a tendency to float in the stratum of menstruum, it may be held down by a few fragments of glass. The percolator is then ready to receive the menstruum or weak percolate, and a stratum of the liquid should be carefully kept covering the entire surface until the whole mass of the substance to be percolated is saturated. The cork is to be taken from the well tube before the liquid is poured on, and then the liquid will flow down into the substance like a piston, pushing the interstitial air before it, the air passing out through the blankets and the well tube; finally the liquid will rise in the well tube until its surface is within an inch or so of the surface of the liquid outside.

The whole substance is now in a perfect condition for maceration, and the surface should be left covered with the liquid to the depth of at least half an inch. A short section of rather thick rubber tubing should be stretched over the upper end of the well tube, and slipped

down so as to support the centre of the cover. A tightly fitting cover, made of sheet rubber a quarter of an inch thick, with a hole in the centre for the well tube, is then put on. The syphon is made of glass tubing of about an eighth of an inch bore, bent twice at right angles, the two legs being each about twelve inches long. The outer leg is a little longer than the inner one, and turned up upon itself for about three-quarters of an inch, as shown in Fig. 406. The legs should have only such a difference in length that the inner one will reach the bottom of the well tube when required, and when measured upon the outer one will reach to about midway of its turned up end.

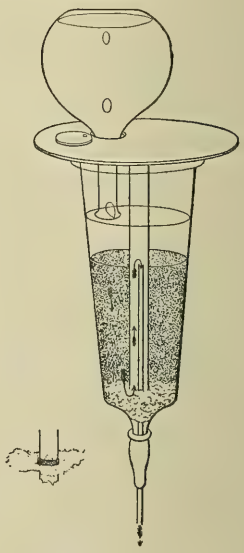
This construction prevents the syphon from emptying itself at any time, for when the liquid is drawn over by the syphon until the surface of liquid in the well tube falls to a level with the end of the turned up portion, as shown by the lines in Fig. 406, the columns of liquid in the syphon will be of equal length and will counterbalance each other, and the flow will cease without emptying the syphon. But as soon as the level of the liquid in the well is raised by fresh

Fig. 407



Appert glass well tube percolator

Fig. 408



Double tube percolator

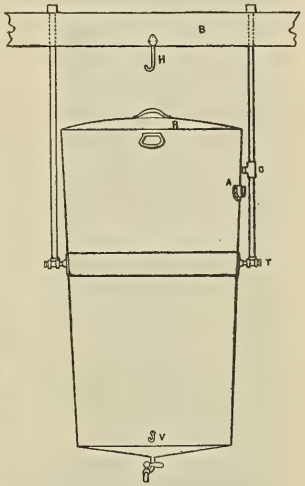
additions of menstruum on the substance, the flow will recommence at a rate proportionate to the difference of levels, and may be readjusted to the required rate by slipping the syphon up or down in the cork in the upper end of the well tube. This cork should be bored to fit the syphon so tightly as to hold it in any position, and should have a groove filed longitudinally on its outer side, to allow free exit of air. Fig. 407 shows the well tube percolator made of Appert glass, furnished by the Mississippi Glass Company, of New York.

If it is desirable at any stage in the percolation to stop the process, the syphon may be gently lifted until the leg in the well tube is above

the level of the percolate there, when the flow will cease. It may be started by simply pushing the leg down into the tube again. This is a practical convenience which is greatly appreciated. If the syphon should accidentally empty itself, the flow is easily started by attaching a short rubber tube to the curved end and applying suction.

Double Tube Percolator.—This differs from the well tube percolator just described in the use of an ordinary percolator, the absence of the syphon, and the substitution of a simple, straight tube which is free to move up and down inside of the well tube at the discretion of the operator. Fig. 408 illustrates its mode of action. A central well tube having the lower end irregularly broken is placed in an ordinary glass percolator, upon a tuft of absorbent cotton, or, as in Dr. Squibb's percolator, a circular piece of muslin is securely tied upon the tube a short distance from the bottom, as shown in the small cut in Fig. 408, and the end of the tube rests upon a perforated cork fitting tightly in the neck of the percolator, as proposed by W. S. Thompson in his description of a similar apparatus. The control of the flow of the percolate is effected by raising or lowering the small tube which passes into the well tube, and which is held in place by passing through the perforated cork in the neck of the percolator already mentioned, or through a perforated rubber nipple slipped over the end, as suggested by Windolph, or through a piece of rubber tubing. If previous maceration is directed, the narrow tube may be pushed up until the upper orifice is above the level of the menstruum, and of course above the level of the percolate in the well tube. When it is desirable to begin percolating, the tube is gently rotated with a downward movement until the level of the percolate is reached, and then percolation proceeds regularly, the course of the menstruum being indicated by the arrows in Fig. 408. The rapidity of the flow is increased by lowering the tube, and decreased by raising it.

Fig. 409

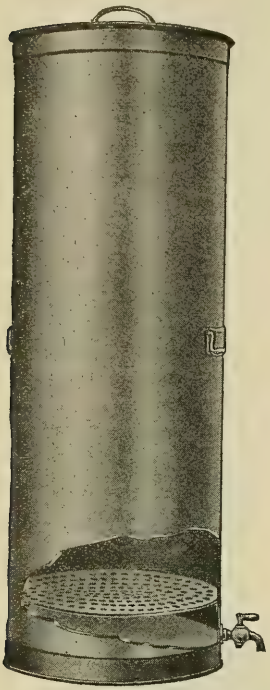


Suspended percolator (Hance's)

Suspended Percolator.—In large operations it is necessary to employ means to facilitate not only the percolation, but also the packing and emptying and other subordinate but essential parts of the process. Fig. 409 shows a percolator in use by Hance Brothers & White. The large percolator of tinned copper is suspended by trunnions, T, which are fastened to a stout band encircling the percolator slightly above the centre; two steam pipe supports are secured to a strong beam, B, above, and the trunnions rest in tees, which are screwed to the end of the pipe supports. The sliding tee, G, is dropped into the cup shaped catch, A, when it is desired to retain the percolator in an upright position. The special advantage in this arrangement is observed, however, when an operation is concluded. A residue car may then be wheeled opposite to the percolator, and the tee pushed up so

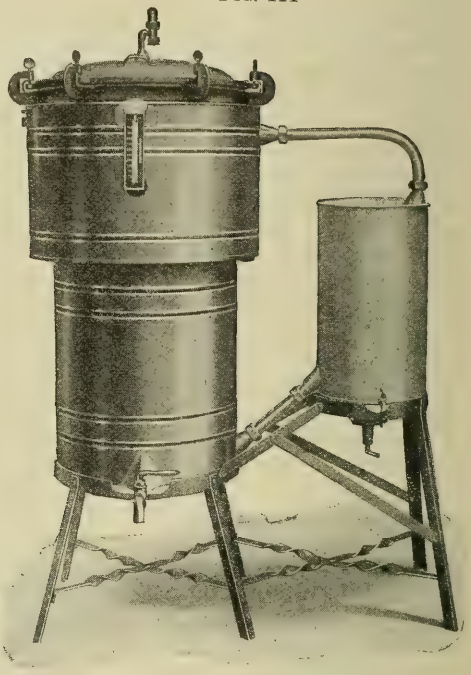
as to permit the percolator to swing on the trunnions. The percolator may then be turned upside down with the greatest ease, and

Fig. 410



Copper percolator (Colton)

Fig. 411

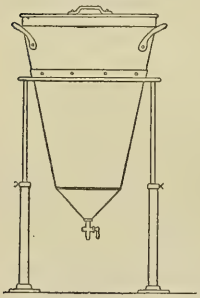


Hardesty vanilla percolator

fastened by attaching the bottom to the hook H; its conical shape facilitates the discharge of the residue.

Percolation on the Large Scale.—It is obvious that somewhat different appliances must be used in percolating large quantities of drugs. While ordinary glass percolators cannot be made of very large size, well tube percolation is well adapted for large operations, but tinned copper percolators are most frequently employed; in the latter brass stopcocks are mainly depended upon for controlling the flow of the percolate, but these are objectionable because of the difficulty in cleaning them, and on account of the liability of becoming enveloped in evaporated percolate it is often difficult to start or control the flow accurately. Figs. 410 and 411 illustrate copper percolators, made by Arthur Colton, of Detroit, with diaphragms for supporting the disk of flannel or cloth. They are intended to be placed upon counters or tables. Fig. 412 shows an ordinary copper percolator supported by a ring on two columns,

Fig. 412

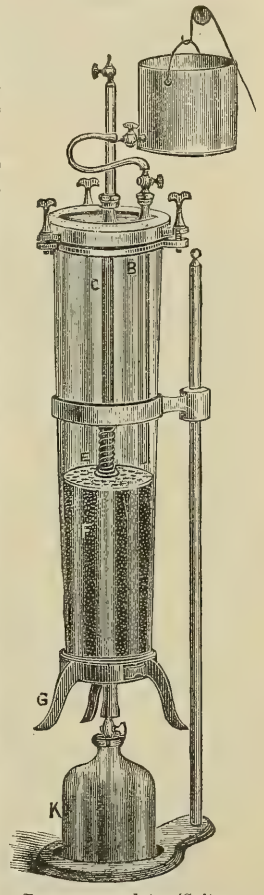


Copper percolator

with sufficient space below to accommodate the receiving bottles. These may be made so as to be supported on trunnions (see Fig. 409). The exhausted powder or marc is then easily turned out into a vessel placed on the floor.

Pressure Percolators.—Percolation by pressure has come into vogue in various parts of the country, and there are at the present time several forms of pressure percolators upon the market, each one differing somewhat from the others in detail, but all based upon the same principle,—that of forcing the menstruum through the powder at a greater rate of speed than it would pass if it depended alone on the force of gravity.

Fig. 413



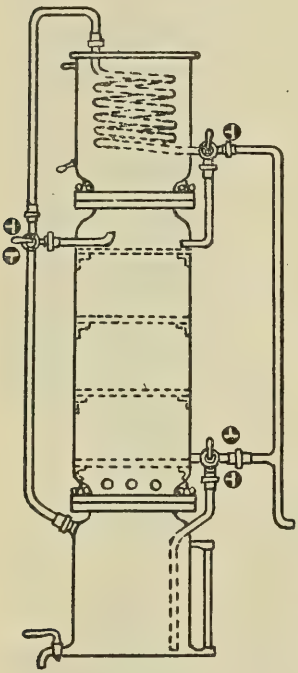
Pressure percolator (Suits)

The pressure is usually exerted through a column of menstruum entering the percolator at the top, the menstruum being supplied and the column sustained from a reservoir of the liquid suspended above it at a height of from three to ten feet. It will be noticed that Count Real's apparatus, invented in 1815, was based upon this principle (see page 280), and since then Stearns, Rosenwasser, Berry, Suits, Anderson, and others have advocated or introduced apparatus under various names by which percolation is carried on under pressure. It must suffice in this place to describe briefly one pressure percolator, that of Suits, full and detailed information being readily obtained from the manufacturers of any of them. Fig. 413 shows one of the best forms, the glass percolator B, protected by three iron bands, having at the top a tight cover made of plated sheet copper, having two stopcocks; the cover is made airtight by being clamped between two flat sheet rubber rings; the bottom of the percolator has a stopcock cemented in it; the moistened powder, F, is kept in place and some pressure exerted by means of the porous metal diaphragm, the spring E, and the metal tube, C, which passes through an air tight joint in the top. The tripod, G, is not used during the percolation, but is useful in supporting the percolator while packing. It is possible with this apparatus to macerate the powder under pressure, and at the end, after all of the menstruum has been run into the percolator and hydrostatic pressure is no longer available, a convenient rubber bulb airpump may be used to force air into the percolator to maintain the pressure. This apparatus may be used to great advantage in filtering oils under pressure, or as a bottle filler. After an extended practical trial of percolation by pressure, the author has reached the conclusion, that, while there are some percolating operations in which it can be used with advantage, for the great majority the pressure is unnecessary, just as perfect results being reached by the use of as

simple a percolator as a glass funnel or cylinder of the well known form.

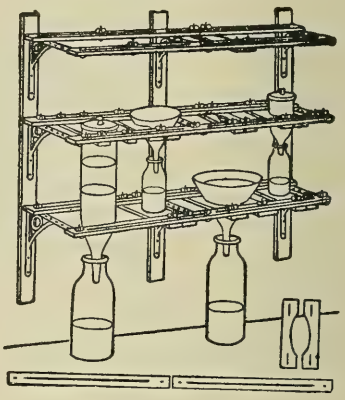
Percolation with Hot Extraction.—In some cases it is desirable to exhaust drugs with hot menstrua. Lewin's extraction apparatus is shown in Fig. 414. The lower vessel is a still; immediately above it is the percolator having three movable sieves for the reception of the substance to be extracted; above the percolator is the condenser. By the use of the three-way stopcocks, the percolation, distillation, and extraction may be controlled at will. Fig. 411 illustrates the Hardesty vanilla percolator in which the principle of hot extraction is used. It is claimed for this outfit that complete exhaustion of the vanilla beans,

Fig. 414



Lewin's extraction apparatus

Fig. 415



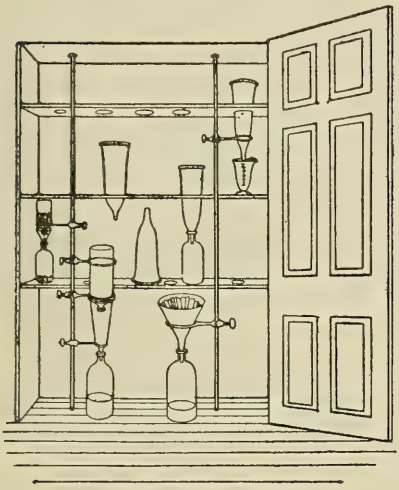
Percolator stand

prevention of loss from evaporation, rapidity of extraction and the avoidance of contamination from other flavors and odors of the laboratory make the adoption of this process of great value to the large manufacturer of flavoring extracts. The menstruum percolates through the drug, the percolate is then heated until vaporized and afterwards recondensed over the drug. This alcoholic liquid again percolates through the drug and the process is continued until complete exhaustion of oil and resin is secured, the temperature being carefully regulated throughout so that the flavor is not injured and undesirable constituents removed.

Methods of Supporting Percolators.—The ordinary retort stands are often used to support percolators, but these are generally flimsy and unsatisfactory. The one shown in Fig. 187, particularly if used with split rubber tube sections, as seen in Fig. 190, is much to be preferred. The stand shown in Fig. 415 was devised by the author in 1875, and has been in constant use since. It is conveniently fastened to the wall in front of the working counter. Two long strips having slots down the centre are supported on brackets, and short cross strips

having their inside edges hollowed out are fastened to the long strips by thumb screws. This arrangement permits the adjustment of the cross strips so that either a large or a small percolator or funnel can

Fig. 416

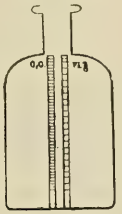


Percolation closet (Shinn)

Fig. 417a

Receiving flask

Fig. 417b

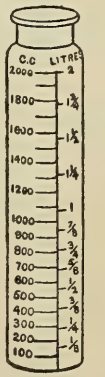


Receiving bottle

be supported, as shown in the cut, at any desired height. This stand is capable of enlargement by means of additional brackets and strips. If a wall counter is not available, a frame may be made extending over an ordinary counter, which will serve as well for a support, care being taken that the strips and frame are heavy enough to bear without strain any weight likely to be placed upon the stand. The special advantage of a percolating stand is that it enables all percolating and filtering operations to be carried on with convenience in one place, thus saving time and labor.

Percolation Closet.—The retort rings shown in Fig. 187 have been used by James T. Shinn in a convenient percolation closet, shown in Fig. 416. Two lengths of ordinary five-eighths-inch iron steampipe are fastened securely to the top and bottom of the closet, at a convenient distance from the shelves. The retort rings may be adjusted to the desired height, and it is thus possible to carry on several percolations or filtrations at the same time, away from the other operations of the store, in a closet with a closed door.

Fig. 418



Receiving bottle (all glass)

Receiving Bottles.—A series of bottles of various sizes should be reserved for use in receiving percolates. Where especial accuracy is necessary, a flask with a double mark on the neck should be used (see Fig. 417a). Bottles with comparatively wide necks are to be preferred for receiving bottles. A strip of adhesive plaster may be pasted on the side, and accurately measured quantities of water poured in, carefully marking the height of each addition; upon the opposite side corresponding metric quantities may also be placed (see Fig. 417b). Narrow receiving bottles (metric and old form, and both systems on the same bottle) (Fig. 418) are now available. The graduations are accurately engraved on the glass, and arranged, at the author's suggestion, to suit the quantities usually

made by the pharmacist. These, unlike the home-made receivers, are permanently marked and of elegant appearance.

Repercolation.—This, as its name indicates, is the process of percolating substances with percolates, or, as defined by Dr. E. R. Squibb, the author of the process, "the successive application of the same percolating menstruum to fresh portions of the substance to be percolated." The principal object of repercolation is to effect the saving of alcohol and alcoholic menstrua by accomplishing the saturation of the menstrua, as nearly as possible, by passing the unsaturated or weaker percolate from one portion of the drug through another portion, and again passing the unsaturated or weaker percolate from this second portion through a third portion. The weak percolate from this last portion is generally set aside, to be used in succeeding operations upon the same drug in the place of fresh menstruum. This process is useful only in those operations where the relative proportion of menstruum used is small, as in the fluidextracts and similar concentrated preparations. Practical illustrations of the use of this process may be seen by referring to the chapter on Fluidextracts where the principle has been adopted in Type Process C, for Fluidextracts.

Fractional Percolation.—This is a term employed by Prof. C. Lewis Diehl and others to define percolation when applied to two successive portions of powder, the principle of action being identical with that of repercolation.

QUESTIONS ON PERCOLATION

What is percolation or displacement? (See page 280.) What is lixiviation?
To whom belongs the credit of first demonstrating the value of the process of percolation in its pharmaceutical applications?
What is the principal of action in displacement?
What is the instrument used to hold the powder called?
What is the liquid poured on the top of the powder called?
What is the liquid which passes through the powder called?
According to directions given in the U. S. Pharmacopœia, in what does the process of percolation consist?
When the process is successfully conducted, how will the first portion of the percolate compare with the succeeding portions as regards color, odor, etc.?
What shape or shapes are most suitable for percolating such quantities as are directed by the U. S. P.?
Of what material may it best be constructed?
Give the directions for preparing and putting into the percolator a powder for percolation.
Give directions for pouring on the menstruum and starting the percolation.
How may the flow of the percolate be regulated so as to run with greater or less rapidity?
How may a layer of menstruum be kept constantly above the powder, and why is this desirable?
In what cases may narrow percolators be advantageously used, and in what cases wide ones?
Why is a narrow percolator preferable for making fluidextracts?
Upon what depends the proper degree of comminution for a substance to be subjected to percolation?
What happens when a powder of unequal degrees of fineness is subjected to percolation?
What is the object of moistening a powder before subjecting it to percolation?
In what special cases should the substance not be moistened?
What is the object of directions for packing powders in percolation, such as "pack it moderately," "pack it firmly," etc.?
In packing a percolator or funnel, how is the powder prevented from running through?
How should a powder be packed in a percolator so as to insure its being packed uniformly?
After adding a portion of menstruum to a powder in a percolator, should the surface be allowed to become dry, or should the supply of menstruum be continuous? Why? Is maceration previous to percolation desirable? Why?
In the process of percolation the direction is often given, "add the menstruum until the substance is exhausted." How may it be known when a drug is exhausted? Give examples.
In the choice of menstrua, in what case would alcohol be indicated? In what cases diluted alcohol? Where would the addition of glycerin be advisable?
What advantage has percolation or maceration as regards the absorbed liquid left in the residue? How can alcohol absorbed in residues be recovered?
How can the alcohol so recovered be purified?
Describe several simple methods for controlling the flow of the percolate.
What directions are given in the U. S. P. for regulating the "rate of flow" of the percolate? Describe Dursse's percolator. Dr. Squibb's well tube percolator, the double-tube percolator.
What is the object of having a percolator suspended on trunnions?
What kind of percolators are chiefly used for large operations?
Describe percolation by pressure?
How may drugs be exhausted with the aid of a hot menstruum?
Describe the Hardesty vanilla percolator. What are its advantages?
How are percolators ordinarily supported? What is the objection to the ordinary retort stands?
Describe a percolating stand that would be more satisfactory.
What is the advantage of a percolating closet?
How may receiving bottles be conveniently marked? What is repercolation?
What is its principal object? In what operations is repercolation useful? What is fractional percolation?

PART II

OFFICIAL PHARMACY

THE various processes which are used in making the official preparations having been considered in Part I, as solution, filtration, digestion, percolation, maceration, expression, etc., it is most appropriate now to take up these preparations and classify them. Those which form natural groups will be brought together in such a manner as to facilitate the study of their general features. Each chapter will begin with a definition and description of the class of preparations of which it treats; then will follow a table giving a succinct view of the individual preparations forming the class; and after this, the official processes will be found arranged alphabetically. Detailed comments upon the preparations are reserved for the subsequent chapters, the object being at this time to familiarize the student with the *various forms* of official preparations and fix their general characteristics upon the mind. A table of abbreviated unofficial formulas will be found after each class, containing mainly preparations of the U. S. P. 1890 or of the Eighth Revision which have been dropped, and also those of the British Pharmacopœia (1914). The following diagram will serve to give a complete view of the classification; it should be carefully examined at the outset, and referred to again after the classes have been studied in detail:

OFFICIAL PREPARATIONS [1]

LIQUIDS		SOLIDS	
Made without percolation or maceration	Made by percolation or maceration	Made by percolation or maceration	Made without percolation or maceration [2]
Aqueous Solutions	**Aqueous Liquids**		Powders
Waters	Infusions	Extracts	Effervescent Salts
Diluted Acids	Decoctions	Resins	Oil Sugars
Solutions	Teas		Triturations
Aqueous Solutions containing Sweet, Viscid, or Suspended Substances	**Alcoholic Liquids**		Masses
	Tinctures		Confections
	Wines		Pills
Syrups	Fluidextracts		Tablets
Honeys	**Glycerin Liquids**		Troches
Oxymels	Fluidglycerates		*Cerates*
Mucilages	**Oleoresinous Liquids**		*Ointments*
Emulsions	Oleoresins		*Inunctions*
Magmas	**Oily Liquids**		Glycerogelatins
Mixtures	*Infused Oils*		Pastes
Gargles	**Acetous Liquids**		*Cataplasms*
Lotions	Vinegars		*Plasters*
Glycerites			*Mulls*
Alcoholic Solutions			*Papers*
Spirits			Suppositories
Elixirs			Bougies and Catheters
Cordials			*Pencils*
Ethereal Solutions			
Collodions			
Oleaginous Solutions			
Liniments			
Oleates			
Petroxolins			
Sprays			
Medicated Oils			

[1] Those used internally are in Roman type; those used externally, in Italics.
[2] The preparations in this class are mostly extemporaneous, and will be considered under Part V.

CHAPTER XXI

AQUEOUS SOLUTIONS
Aquæ *Waters*

The class of preparations termed *waters* are known also as medicated, aromatic, or distilled waters, and may be simply defined as *aqueous solutions of volatile substances.* The German Pharmacopœia and French Codex, however, recognize as waters solutions of non-volatile substances. The volatile substances used in the preparation of waters are either solid, liquid, or gaseous, and the following methods have been employed in effecting their solution: 1. Simple solution in cold water. 2. Solution in hot water. 3. Filtration through an absorbent powder. 4. Filtration through pulped or shredded filter paper. 5. Percolation through cotton saturated with the substance. 6. Distillation.

Most of the medicated waters are used as pleasant vehicles and solvents for the administration of various remedies, and are solutions of aromatic volatile oils. There are *eighteen* waters official in the U.S.P. IX and *one* in the N.F. IV, excluding ordinary water.

1. **Simple Solution in Cold Water.**—This method is resorted to when the proportion of the volatile substance is small enough to dissolve *easily* in the quantity of water required or when an excess of a volatile liquid is added and, after agitation, immediately filtered. The process consists of agitating the volatile liquid with the water until the latter becomes saturated, and then filtering the solution through a filter paper which has been thoroughly washed with distilled water. The method of making medicated waters by agitation with an excess of volatile oil, permitting the excess to remain and drawing off the water as required, is not recommended on account of the liability of the oil to deteriorate through exposure to light and air. In the case of gaseous solutions, the gas is passed through the water until a solution of the desired strength is obtained. (See Solution of Gases, p. 220.) Of the *nineteen* official waters, *five* are distilled, *two* are solutions of gases, *six* are solutions of volatile oils, *two* are diluted distilled waters, *one* is a solution of a volatile solid, and *three* are solutions of volatile liquids.

Official Waters Made by Simple Solution

Title	Proportion of liquid dissolved	Use and Dose
Aqua Amygdalæ Amaræ	0.1 per cent. by volume of Oil of Bitter Almond	Pleasantly flavored vehicle, f℥i (4 mils)
Chloroformi	Saturated solution	Sedative and vehicle, f℥iv (15 mils)
Creosoti	1 per cent. by volume of Creosote	Antiseptic and used locally, f℥iiss (10 mils)
Phenolata N. F.	About 2 per cent. by volume of Phenol	Antiseptic

Official Waters Made by Passing Gases Through Water[1]

Title	Proportion of gas dissolved	Use
Aqua Ammoniæ	9.5 to 10.5 per cent. of gaseous Ammonia	Stimulant, caustic, 15ℳ (1 mil)
Ammoniæ Fortior	27 to 29 per cent. of gaseous Ammonia	Rubefacient, escharotic

2. **Solution in Hot Water.**—This method is founded upon the fact that most of the volatile oils are much more soluble in hot water than in water of ordinary temperature; hence, if the volatile oil is thoroughly agitated with hot water in a suitable vessel, such as a flask or tin can, and allowed to stand until the excess has separated, if care is used, the water will be found to be saturated; it may then be decanted and filtered.

3. **Filtration through an Absorbent Powder** is the process which has been most frequently employed; the object of using the powder is to thoroughly divide the oil, or volatile liquid, and expose a greater surface, so that the water in filtering through it may become completely saturated. Magnesium carbonate was frequently used for this purpose, but is sometimes objectionable on account of its slight solubility in water; this causes the latter to show a trace of alkalinity. Calcium phosphate, kaolin, powdered glass, silica, powdered pumice-stone, charcoal, precipitated chalk, sugar, etc., have been suggested as substitutes, but there are quite as forcible objections to be urged against these as against the magnesium carbonate. Where solutions of alkaloids or of silver nitrate are needed, distilled water alone and not an aromatic water should be used. The Pharmacopœia recommends the use of purified talc, in not finer than a No. 100 powder, for this purpose, with purified siliceous earth or pulped filter paper as alternatives, but purified magnesium carbonate is preferable.

4. **Filtration through Pulped or Shredded Filter Paper.**—This process is permitted by the U. S. Pharmacopœia (9th Revision) and consists in dropping the volatile oil upon white filter paper or filter paper pulp, tearing this into shreds, transferring it to a flask or stone-ware jug, adding boiling distilled water in portions, and shaking it thoroughly. When the liquid is cold, it is filtered and the quantity adjusted by pouring distilled water through the filter.

5. **Percolation through Cotton Impregnated with the Substance.**—This was the process directed to be used in the U. S. P. 1880; it was abandoned in the revision of 1890 on account of its inconvenience and wastefulness. The oil or volatile liquid is distributed upon the fibres of cotton, which are then pulled apart in order to secure thorough division; the saturated cotton is packed in a funnel, and the water poured upon it. In its passage downward the water dissolves the oil and passes out impregnated with the odorous substance. The presence of undissolved floating oily drops in the finished preparation has constituted one of the greatest objections to this process. It is an improvement to insert a plug of dry cotton in the throat of

[1] Chlorine water will be found among the reagents (see Chapter LXII; see also Liquor Chlori Compositus, Part III).

the funnel before placing the saturated cotton in position; this prevents the oily drops which may escape solution from being carried down by the water as it percolates through. Too much care cannot be exercised in selecting the volatile oils, which should be fresh and of the best quality.

Official Waters Made by Filtration Through an Absorbent Powder

Title	Proportion	Use and Dose
Aqua Anisi	0.2 per cent. by volume of Oil of Anise	Pleasant vehicle, f℥iv (15 mils)
Camphoræ	0.8 per cent. of Camphor dissolved with the aid of 0.8 per cent. of Alcohol; the Alcohol is allowed to evaporate during the process	Mild antispasmodic, f℥iiss (10 mils)
Cinnamomi	0.2 per cent. by volume of Oil of Cinnamon	Pleasant vehicle, f℥iv (15 mils)
Fœniculi	0.2 per cent. by volume of Oil of Fennel	Pleasant vehicle, f℥iv (15 mils)
Menthæ Piperitæ	0.2 per cent. by volume of Oil of Peppermint	Pleasant vehicle, f℥iv (15 mils)
Menthæ Viridis	0.2 per cent. by volume of Oil of Spearmint	Pleasant vehicle, f℥iv (15 mils)

6. **Distillation.**—This is the best process for preparing medicated waters, and should be used wherever practicable. If the fresh drug can be procured, it should always be used in preference to that which has been dried, because in the process of desiccation there is usually a loss of the agreeable volatile constituents. Metallic distillatory apparatus is preferably employed (see page 176). If the drug containing the oil-cells has a loose structure and is quickly penetrated by hot water, so that the oil-cells are easily ruptured, the drug may be introduced without previous contusion or grinding; it will usually be found, however, most economical to cut or grind the drug coarsely. Most distilled waters acquire an unpleasant empyreumatic odor as soon as they are distilled; this passes off gradually upon exposure to air, if care has been taken not to expose the drug to the action of direct heat during distillation. If no precautions are taken to protect the drug from partial burning, the odor of the carbonized substance will always be noticeable in the distilled water, rendering the product worthless. Fig. 213 shows a copper wire cage contrived by the author to obviate the difficulty just described; the surface of the cage is hemispherical; it rests, after being partially filled with the drug, upon the flat bottom of the still, and thus the contact of the substance with the heated surface is avoided; the meshes of the cage are coarse enough to permit the free passage of vapors and the boiling water through them. Although distillation by the use of steam may be most convenient upon the large scale, Vuaflart and Machet have shown that rose and orange flower waters distilled over a naked fire keep better than those distilled by steam heat.

Preservation.—Distilled waters should not be made in larger quantities than can be used within a reasonable time, because they deteriorate when long kept, a flocculent precipitate forming in them, and ultimately they lose all traces of their usually agreeable odor. Microscopic plants belonging to the order Confervæ will often be found in medicated waters. These are usually tufts of articulated filaments, propagated by very minute spores from the atmosphere, which have

found lodgement in the water. Their presence renders the medicated water unsightly, and when in large proportion they must be regarded as injurious. The Pharmacopœia has directed the use of recently boiled, distilled water to avoid, as far as possible, the presence of micro-organisms in the water used. The sterilized water is introduced into a sterilized bottle with a side opening (like a douche-bottle) to which a sterilized rubber tube with a pinchcock is attached, and the bottle is then closed with a pledget of sterilized cotton. The organisms and spores originally present in the water having been destroyed by the heat, the future growth of confervæ is prevented by the interception of the spores by the cotton. It usually suffices, however, to preserve the medicated water in small bottles, which are completely filled, tightly sealed, and kept in a cool, dark place. Alcohol is sometimes added as a preservative, but this generally serves its purpose for only a short time, as it cannot be added in sufficient quantity to preserve the water permanently, on account of its interference with the therapeutic action. Glycerin and syrup have been suggested as preservatives. In the writer's experience they are not of much value, for they would have to be used in large and inadmissible quantities.

Official Waters Made by Distillation

Title	Proportion of material used	Use and Dose
Aqua Aurantii Florum Fortior	Water saturated with Oil of Fresh Orange Flowers	Used for making Orange Flower Water, f℥ii (8 mils)
Aurantii Florum	Stronger Orange Flower Water, Distilled Water, each, 1 vol.	Mild sedative vehicle, f℥iv (15 mils)
Destillata	750 parts distilled from 1000 parts of water	Solvent
Destillata Sterilisata	Sterilized, freshly distilled water	Solvent
Hamamelidis	Saturated distillate from the bark, twigs, or entire shrub of Hamamelis with the addition of 15 per cent., by volume, of Alcohol	Used as a lotion
Rosæ Fortior	Water distilled in contact with fresh Rose flowers	Used for making Rose Water, f℥ii (8 mils)
Rosæ	Stronger Rose Water, Distilled Water, each, 1 vol.	Pleasant vehicle, f℥iv (15 mils)

The U. S. P. IX has introduced the following general process for Waters made from volatile oils:

AQUÆ AROMATICÆ. U. S. **Aromatic Waters**

Aromatic Waters, when prepared from volatile oils, are intended to be, as nearly as practicable, saturated solutions, which must be clear and free from solid impurities, and, unless otherwise directed, should be made by the following general process:

General Process

	Metric	Old form
***Volatile Oil**	2 mils	30 minims
Purified Talc	15 Gm.	220 grains
Distilled Water, recently boiled	1000 mils	2 pints

Triturate the volatile oil with the purified talc, add the recently boiled distilled water gradually with continued trituration, filter, and pass the filtrate through the filter repeatedly until the Aromatic Water is perfectly clear.

If preferred, the solution of the volatile oil may be made by replacing the purified talc by purified siliceous earth, or by pulped filter paper; or a solution of the volatile oil may be prepared with recently boiled distilled water, by direct addition and filtration, after shaking. Aromatic Waters may also be made by the distillation of a mixture of the drug or volatile oil with water. In each case the method used must yield a finished product which meets the official requirements and corresponds with that obtained by the general process. Aromatic Waters should not be permitted to freeze.

AQUA AMYGDALÆ AMARÆ. U. S. Bitter Almond Water
[Aq. Amygd. Amar.]

	Metric	Old form
***Oil of Bitter Almond**	**1 mil**	15 minims
Distilled Water, recently boiled	**999 mils**	2 pints
To make	**1000 mils**	2 pints

Dissolve the oil of bitter almond in the recently boiled distilled water by agitation, and filter.

NOTE.—Bitter Almond Water contains a mere trace of hydrocyanic acid and differs from the preparation of the same name, recommended by the International Protocol, 1906, which contains 0.1 per cent. of hydrocyanic acid.

Average dose.—1 fluidrachm (4 mils).

AQUA ANISI. U. S. Anise Water
[Aq. Anisi]

	Metric	Old form
***Oil of Anise**	**2 mils**	30 minims
Purified Talc	**15 Gm.**	220 grains
Distilled Water, recently boiled, a sufficient quantity,		
To make	**1000 mils**	2 pints

Triturate the oil with the purified talc, add the recently boiled distilled water gradually, with continued trituration, filter, and pass the filtrate through the filter repeatedly until the Water is perfectly clear.

Average dose.—4 fluidrachms (15 mils).

AQUA AURANTII FLORUM. U. S. Orange Flower Water
[Aq. Aurant. Flor.]

	Metric	Old form
***Stronger Orange Flower Water**	**500 mils**	8 fl. oz.
Distilled Water, recently boiled, each, one volume,		
To make	**1000 mils**	1 pint

Mix them immediately before use.

Orange Flower Water complies with the tests for identity and purity given under *Aqua Aurantii Florum Fortior.*

U. S. P. Preparations.—Syrupus Aurantii Florum; Syrupus Lactucarii.
N. F. Preparations.—Liquor Hypophosphitum Compositus; Liquor Phosphatum Compositus; Syrupus Ferri Hypophosphitis; Syrupus Ferri Protochloridi.

Average dose.—4 fluidrachms (16 mils).

AQUA AURANTII FLORUM FORTIOR. U. S. Stronger Orange Flower Water

[Aq. Aurant. Flor. Fort.]

The saturated aqueous distillate prepared by distilling the fresh flowers of *Citrus Aurantium amara* Linné (Fam. *Rutaceæ*) with water. Preserve it in bottles stoppered with a pledget of purified cotton and in a dark, cool place.

Official Description.—Colorless and clear or only faintly opalescent.

Odor, Taste, and Reaction.—Possesses a strong and pleasant odor and taste of orange blossoms; neutral or only slightly acid to litmus.

Impurities and Tests for Impurities.—Free from empyreuma, mustiness, or mucoid growths.

Residue.—100 mils, when evaporated to dryness on a water bath and the residue subsequently dried in an oven to constant weight at 100° C. (212° F.), yields not more than 0.001 Gm. of residue.

Metallic Impurities.—This residue gives no reaction with hydrogen sulphide T.S. or with sodium sulphide T.S.

U. S. P. Preparations.—Aqua Aurantii Florum; Syrupus Calcii Lactophosphatis; Trochisci Acidi Tannici.

N. F. Preparations.—Elixir Amygdalæ Compositum; Elixir Aurantii Amari; Elixir Glycyrrhizæ Aquosum.

Average dose.—2 fluidrachms (8 mils).

AQUA CAMPHORÆ. U. S. Camphor Water

[Aq. Camph.]

	Metric	Old form
***Camphor**	8 Gm.	117 grains
Alcohol	8 mils	123 minims
Purified Talc	15 Gm.	220 grains
Distilled Water, recently boiled, a sufficient quantity,		
To make	1000 mils	2 pints

Triturate the camphor with the alcohol in a mortar, add the purified talc; continue the trituration until the alcohol has evaporated and add the recently boiled distilled water. Filter the mixture, and pass the filtrate repeatedly through the filter until the Camphor Water is perfectly clear.

N. F. Preparations.—Mistura Camphoræ Acida; Mistura Camphoræ Aromatica.

Average dose.—2½ fluidrachms (10 mils).

AQUA CHLOROFORMI. U. S. Chloroform Water

[Aq. Chlorof.]

***Chloroform,**
Distilled Water, recently boiled, each, a sufficient quantity.

To a convenient quantity of recently boiled distilled water, contained in a dark amber-colored bottle, add enough chloroform to maintain a slight excess of the chloroform after the contents have been repeatedly and thoroughly shaken. Preserve it in a cool, dark place.

When Chloroform Water is required for use, pour off the needed quantity, refill the bottle with recently boiled distilled water and saturate it by thorough agitation, taking care that there be always an excess of chloroform present.

Because of the preservative action of Chloroform, the Water is added to a menstruum in a number of preparations. Decomposition is thus avoided and the Chloroform is afterwards evaporated during the concentration of the percolate. It is used in this manner in the following preparations:

U. S. P. Preparations.—Extractum Glycyrrhizæ Purum; Fluidextractum Glycyrrhizæ.

N. F. Preparations.—Extractum Ergotæ Aquosum; the Fluidglycerates.

Average dose.—4 fluidrachms (15 mils).

AQUA CINNAMOMI. U. S. Cinnamon Water

[Aq. Cinnam.]

	Metric	Old form
***Oil of Cinnamon**	**2 mils**	**30 minims**
Purified Talc	**15 Gm.**	**220 grains**
Distilled Water, recently boiled, a sufficient quantity,		
To make	**1000 mils**	**2 pints**

Triturate the oil with the purified talc, add the recently boiled distilled water gradually, with continued trituration, filter, and pass the filtrate through the filter repeatedly until the Water is perfectly clear.

U. S. P. Preparations.—Infusum Digitalis; Mistura Cretæ.

N. F. Preparations.—Mistura Guaiaci; Syrupus Cinnamomi; Syrupus Ipecacuanhæ et Opii; Tinctura Ferri Pomata; Tinctura Rhei Aquosa.

Average dose.—4 fluidrachms (15 mils).

AQUA CREOSOTI. U. S. Creosote Water

[Aq. Creosot.]

	Metric	Old form
***Creosote**	**10 mils**	**154 minims**
Distilled Water, recently boiled	**990 mils**	**31 fl. oz. 326 min.**
To make	**1000 mils**	**2 pints**

Agitate the creosote vigorously with the recently boiled distilled water and filter, returning the filtrate to the filter until it is perfectly clear. This preparation must not be dispensed unless it has been recently prepared.

Average dose.—2½ fluidrachms (10 mils).

AQUA DESTILLATA. U. S. Distilled Water

[Aq. Dest.]

Water [$H_2O = 18.016$] purified by distillation.

Water	**1000 Vol.**
To make	**750 Vol.**

Distil the water from a suitable apparatus provided with a block-tin or glass condenser. Collect the first 100 volumes and reject this portion. Then collect 750 volumes and keep the Distilled Water in glass-stoppered bottles, which have been rinsed with hot distilled water immediately before being filled.

For the U. S. P. IX standards and tests for Distilled Water see Part III.

AQUA DESTILLATA STERILISATA. U. S. Sterilized Distilled Water

[Aq. Dest. Steril.]

Water, freshly distilled, a sufficient quantity.

Transfer the necessary quantity of freshly distilled water to a flask of hard glass of sufficient size which has previously been cleansed and sterilized as described under *Sterilization.* Close the mouth of the flask with a pledget of sterilized purified cotton, boil the contents for thirty minutes and allow the water to cool without removing the cotton plug. Finally protect the mouth of the flask and the cotton pledget from infection through dust by wrapping the top of the flask tightly with paper.

Sterilized Distilled Water should be used within forty-eight hours after its preparation.

It is necessary to carry out the details of this process with great exactness, if the product is to be satisfactory. Freshly distilled water is directed because water is likely to contain many microörganisms even a few hours after distillation and these, even if afterwards destroyed in the sterilization process, render the water unfit for use.

A "hard" or so-called "non-soluble" glass flask is directed, as the ordinary glass flask is slightly soluble in boiling water and if used would partially dissolve in the water. Under these conditions the sterilized water, when cold, would be found to contain numerous crystals of silicates and the water could not be used as a solvent for hypodermic or intravenous injections.

AQUA FŒNICULI. U. S. Fennel Water

[Aq. Fœnic.]

	Metric	Old form
***Oil of Fennel**	**2 mils**	30 minims
Purified Talc	**15 Gm.**	220 grains
Distilled Water, recently boiled, a sufficient quantity,		
To make	**1000 mils**	2 pints

Triturate the oil with the purified talc, add the recently boiled distilled water gradually, with continued trituration, filter, and pass the filtrate through the filter repeatedly until the Water is perfectly clear.

Average dose.—4 fluidrachms (15 mils).

AQUA HAMAMELIDIS. U. S. Hamamelis Water

[Aq. Hamam. Witch Hazel Water Distilled Extract of Witch Hazel]

A saturated aqueous liquid obtained by distilling with steam or water the bark, twigs, smaller stems or the entire shrub of *Hamamelis virginiana* Linné (Fam. *Hamamelidaceæ*) collected in the autumn, and adding 150 mils of alcohol to each 850 mils of distillate. Preserve it in tightly closed containers in a cool place.

Official Description.—A clear and colorless, or not more than faintly opalescent or slightly yellowish liquid.

Odor, Taste, and Reaction.—It has a characteristic odor and taste; neutral or only faintly acid to litmus.

Specific Gravity.—0.979 to 0.982 at 25° C. (77° F.).

Impurities and Tests for Impurities.—It must be free from mucoid or fungous growths and must not have an acetous odor.

Metallic Impurities.—It gives no reaction with hydrogen sulphide T.S. or with sodium sulphide T.S.

Dissolved Impurities.—Evaporate 100 mils of Hamamelis Water to dryness on a water bath; not more than 0 025 Gm. of residue remains.

Formaldehyde.—Add 8 drops of an aqueous solution of resorcinol (1 in 200) to 5 mils of Hamamelis Water and then carefully pour this upon 5 mils of sulphuric acid, contained in a test tube, in such a manner that the two liquids do not mix. After standing for three minutes a rose-red ring does not appear at the line of contact of the liquids nor does a distinct white layer appear above this zone.

Methyl Alcohol.—Ten mils of Hamamelis Water gives no reaction for methyl alcohol when tested as directed under *Alcohol* for the detection of methyl alcohol.

Alcohol Content.—It contains not less than 14 per cent. of absolute alcohol, by volume, when estimated as directed under Determination of alcohol in official preparations (see U. S. P. Test No. 14, Chapter LXII).

AQUA MENTHÆ PIPERITÆ. U. S. Peppermint Water

[Aq. Menth. Pip.]

	Metric	Old form
***Oil of Peppermint**	**2 mils**	30 minims
Purified Talc	**15 Gm.**	220 grains
Distilled Water, recently boiled, a sufficient quantity,		
To make	**1000 mils**	2 pints

Triturate the oil with the purified talc, add the recently boiled distilled water gradually, with continued trituration, filter, and pass the filtrate through the filter repeatedly until the Water is perfectly clear.

N. F. Preparation.—Liquor Sodæ et Menthæ (Alternative with Spearmint Water).

Average dose.—4 fluidrachms (15 mils).

AQUA MENTHÆ VIRIDIS. U. S. Spearmint Water

[Aq. Menth. Vir.]

	Metric	Old form
***Oil of Spearmint**	**2 mils**	30 minims
Purified Talc	**15 Gm.**	220 grains
Distilled Water, recently boiled, a sufficient quantity,		
To make	**1000 mils**	2 pints

Triturate the oil with the purified talc, add the recently boiled distilled water gradually, with continued trituration, filter, and pass the filtrate through the filter repeatedly until the Water is perfectly clear.

N. F. Preparation.—Liquor Sodæ et Menthæ.

Average dose.—4 fluidrachms (15 mils).

AQUA ROSÆ. U. S. Rose Water

[Aq. Ros.]

***Stronger Rose Water,**
Distilled Water, recently boiled, each, one volume.

Mix them immediately before use.

Rose Water complies with the tests for identity and purity described under *Aqua Rosæ Fortior.*

N. F. Preparations.—Linimentum Terebinthinæ Aceticum; Mistura Ferri Composita.

AQUA ROSÆ FORTIOR. U. S. Stronger Rose Water
[Aq. Ros. Fort.]

The saturated aqueous distillate prepared by distilling the fresh flowers of *Rosa centifolia* Linné (Fam. *Rosaceæ*) with water. Preserve it in bottles stoppered with a pledget of purified cotton, in a cool, dark place.

Official Description.—Colorless and clear.
Odor, Taste, and Reaction.—Possesses a strong and pleasant odor and a taste of fresh rose blossoms; neutral or only slightly acid to litmus.
Impurities and Tests for Impurities.—Free from empyreuma, mustiness or mucoid growths.
Residue.—100 mils, when evaporated to dryness on a water bath and the residue subsequently dried in an oven to constant weight at 100° C. (212° F.) yields not more than 0.001 Gm. of residue.
Metallic Impurities.—It gives no reaction with hydrogen sulphide T.S. or with sodium sulphide T.S.

U. S. P. Preparations.—Aqua Rosæ; Unguentum Aquæ Rosæ.
N. F. Preparation.—Confectio Rosæ.

AQUA PHENOLATA. N. F. Phenolated Water
[Aq. Phenol. Carbolic Acid Water]

	Metric	Old form
Liquefied Phenol	**22 mils**	338 min.
Distilled Water	**978 mils**	31 fl. oz. 142 min.
To make	**1000 mils**	2 pints

Mix.

Waters Official in the British Pharmacopœia

Titles	Processes
Aqua Anethi	Saturated aqueous distillate from Dill Fruit [1]
Anisi	Saturated aqueous distillate from Anise Fruit [1]
Aurantii Floris	Saturated aqueous distillate from fresh flowers of the Bitter Orange
Camphoræ	1 Gm. of Camphor dissolved in 2 mils of Alcohol and the solution mixed with enough distilled water to make 1000 mils
Carui	Saturated aqueous distillate from Caraway Fruit [1]
Chloroformi	2.5 per cent., by volume, of Chloroform
Cinnamomi	Saturated aqueous distillate from Cinnamon Bark [1]
Destillata	Water distilled from good natural potable water
Fœniculi	Saturated aqueous distillate from Fennel Fruit [1]
Laurocerasi (Cherry-Laurel)	Aqueous distillate from Cherry Laurel Leaves and containing 0.1 per cent., by weight, of hydrocyanic acid
Menthæ Piperitæ	Saturated aqueous distillate from Oil of Peppermint [1]
Menthæ Viridis	Saturated aqueous distillate from Oil of Spearmint [1]
Rosæ	Saturated aqueous distillate from fresh roses (Rosa damascena)

[1] These waters may be prepared by triturating the corresponding oil with twice its weight of calcium phosphate, adding 500 volumes of distilled water and filtering.

Liquores *Solutions*

Under this head the U. S. Pharmacopœia places all aqueous solutions of non-volatile substances except such as naturally form separate distinctive classes, as the syrups, infusions, and decoctions.

This classification is adopted only in the U. S. Pharmacopœia, the British standard embracing, in addition, gaseous and saccharine solutions, as Liquor Ammoniæ, Liquor Calcis Saccharatus, etc., while the

German Pharmacopœia does not adopt any definite method, solutions of volatile and non-volatile substances both being in the class Aquæ and also in the class Liquores, Aqua Rosæ and Aqua Plumbi together, and Liquor Ammonii Caustici and Liquor Natri Caustici in the same class. Liquor Formaldehydi was added to this class in the U. S. P. (8th Rev.) as upon heating, paraformaldehyde, a solid substance, is formed.

The official solutions constitute a most interesting group of preparations. They are usually very active medicinal agents, and some of them are powerful poisons. The number of solutions official in the U. S. P. IX is *twenty-five*; the number in the N. F. IV is *fifty-two*. The following tables exhibit in condensed form a view of the class Liquores, arranged alphabetically in two classes: 1. Simple aqueous solutions, in which the solid dissolved is not altered in any respect, except so far as depends upon its external form. 2. Chemical aqueous solutions, or those in which the properties of the dissolved body or bodies are changed by chemical action or heat (see page 211).

LIQUORES, U. S. P. IX

1. Simple Solutions (aqueous)

Liquor Acidi Arsenosi	0.975 to 1.025 per cent. As_2O_3, 5 per cent. diluted HCl
Arseni et Hydrargyri Iodidi	0.95 to 1.05 per cent. AsI_3, 0.95 to 1.05 per cent. HgI_2
Calcis	Not less than 0.14 per cent. $Ca(OH)_2$
Cresolis Compositus	50 per cent. Cresol with Linseed Oil Soap
Hypophysis	Water-soluble principles extracted from the posterior lobe of the pituitary body and standardized
Iodi Compositus	From 4.8 to 5.2 per cent. I and 9.8 to 10.2 per cent. KI
Plumbi Subacetatis Dilutus	4 per cent. of Solution of Lead Subacetate
Potassii Hydroxidi	Not less than 4.5 per cent. of KOH
Sodii Arsenatis	0.975 to 1.025 per cent. Exsiccated Sodium Arsenate
Sodii Chloridi Physiologicus	8.5 Gm. Sodium Chloride in 1000 mils of freshly distilled water and the solution sterilized
Sodii Glycerophosphatis	50 per cent. Anhydrous Sodium Glycerophosphate
Sodii Hydroxidi	Not less than 4.5 per cent. of NaOH

2. Chemical Solutions (aqueous)

Liquor Ammonii Acetatis	7 per cent. Ammonium Acetate (Ammonium Carbonate with Diluted Acetic Acid)
Ferri Chloridi	Ferric Chloride, corresponding to from 10 to 11 per cent. of Iron (Made from Iron, HCl, HNO_3, and Distilled Water)
Ferri et Ammonii Acetatis	4 per cent. by volume of Tincture of Ferric Chloride in Diluted Acetic Acid. Solution of Ammonium Acetate, Aromatic Elixir, Glycerin, and Water
Ferri Subsulphatis	Basic Ferric Sulphate, corresponding to from 13 to 14 per cent. of Iron (Made from Ferrous Sulphate, H_2SO_4, HNO_3, and Distilled Water)
Ferri Tersulphatis	Normal Ferric Sulphate, corresponding to from 9.5 to 10.5 per cent. of Iron (Made from Ferrous Sulphate, H_2SO_4, HNO_3, and Distilled Water)
Formaldehydi	37 per cent. by weight of CH_2O
Hydrogenii Dioxidi	3 per cent. by weight H_2O_2, corresponding to not less than 10 volumes of available oxygen
Magnesii Citratis	Magnesium Citrate, corresponding to not less than 1.5 Gm. of MgO in 100 mils of Solution (Made from Magnesium Carbonate, Citric Acid, Syrup, Oil of Lemon, Sodium or Potassium Bicarbonate, and Water)
Plumbi Subacetatis	Lead Subacetate corresponding to not less than 18 per cent. of Lead (Made from Lead Acetate, Lead Oxide, and Distilled Water)
Potassii Arsenitis	Potassium Arsenite corresponding to from 0.975 to 1.025 per cent. of As_2O_3 (Made from Arsenic Trioxide, Potassium Bicarbonate, Compound Tincture of Lavender, and Distilled Water)
Potassii Citratis	8 per cent. anhydrous Potassium Citrate (Made from Potassium Bicarbonate, Citric Acid, and Distilled Water)
Sodæ Chlorinatæ	2.5 per cent. by weight of available Chlorine (Made from Chlorinated Lime, Monohydrated Sodium Carbonate, and Water)
Zinci Chloridi	48.5 to 52 per cent. by weight Zinc Chloride (Made from Zinc, Nitric Acid, Precipitated Zinc Carbonate, HCl, and Distilled Water)

LIQUORES, N. F. IV

1. Simple Solutions (aqueous)

Liquor Antisepticus.....Solution of Boric Acid, Thymol, Eucalyptol, Methyl Salicylate, Oil of Thyme, Menthol, Sodium Salicylate and Sodium Benzoate with 30 per cent. by volume of Alcohol

Antisepticus Alkalinus.....Solution of Potassium Bicarbonate, Sodium Benzoate, Sodium Borate, Thymol, Eucalyptol, Oil of Peppermint, and Methyl Salicylate, with 6 per cent. of Alcohol and 15 per cent. of Glycerin by volume, the whole colored red with Cudbear

Bismuthi.....Bismuth and Sodium Tartrate, corresponding to about 1.6 Gm. of Bismuth Oxide in each 100 mils of Solution (Made from Glycerite of Bismuth, Alcohol and Water)

Bromi.....8.3 per cent. by volume of Bromine with Potassium Bromide and Water

Carmini.....6.5 Gm. of Carmine in 100 mils, using Ammonia Water, Glycerin, and Water

Cocci.....6.5 Gm. of Cochineal in 100 mils, extracted with the aid of Potassium Carbonate, Alum, Potassium Bitartrate, Glycerin, Alcohol, and Water

Ferri Hypophosphitis.....16.5 Gm. of Ferric Hypophosphite in 100 mils, with Potassium Citrate, Glycerin and Water

Guttæ Perchæ.....15 Gm. of Gutta Percha in 100 mils of Chloroform, clarified by Lead Carbonate sedimentation

Hydrargyri et Potassii Iodidi.....About 1 per cent. HgI_2 and 0.8 per cent. KI

Hydrastinæ Compositus.....About 0.3 per cent. of Hydrastine Hydrochloride with Aluminum Chloride, Calcium Chloride, Magnesium Chloride, Potassium Chloride, Glycerin and Distilled Water

Hypophosphitum.....Made from Calcium, Sodium and Potassium Hypophosphites with Hypophosphorous Acid and Distilled Water

Hypophosphitum Compositus.....Made from Calcium, Potassium, Sodium, Ferric, Manganese, and Quinine Hypophosphites, Strychnine and Potassium Citrate, with Hypophosphorous Acid, Orange Flower Water, Glycerin and Distilled Water

Iodi Phenolatus.....Made from Compound Solution of Iodine, Liquefied Phenol, Glycerin, and Water

Magnesii Sulphatis Effervescens.....25 Gm. Magnesium Sulphate in 350 mils, with Citric Acid, Syrup of Citric Acid, Potassium Bicarbonate and Distilled Water

Pancreatini.....1.75 Gm. of Pancreatin in 100 mils, with Sodium Bicarbonate, Glycerin, Compound Spirit of Cardamom, Alcohol, Magnesium Carbonate, Sodium Chloride, and Distilled Water, with Chloroform as a preservative

Pepsini.....5 per cent. by volume of Glycerite of Pepsin with Hydrochloric Acid, Glycerin and Distilled Water

Pepsini Antisepticus.....5 Gm. of Pepsin in 100 mils, with Menthol, Eucalyptol, Methyl Salicylate, Alcohol, Glycerin, Diluted Hydrochloric Acid and Distilled Water

Pepsini Aromaticus.....1.75 Gm. of Pepsin in 100 mils, with Oils of Cinnamon, Pimenta, and Clove, Alcohol, Hydrochloric Acid, Glycerin and Distilled Water

Phosphori.....0.07 Gm. of Phosphorus in 100 mils, with Spirit of Peppermint, Glycerin and Dehydrated Alcohol

Picis Alkalinus.....25 Gm. of Tar in 100 mils, with Potassium Hydroxide and Water

Picis Carbonis.....Made from Coal Tar, Quillaja and Alcohol

Sodæ et Menthæ.....5 Gm. of Sodium Bicarbonate in 100 mils, with Aromatic Spirit of Ammonia and Spearmint or Peppermint Water

Sodii Arsenatis, Pearson.....0.1 per cent. of Exsiccated Sodium Arsenate in Distilled Water (Note: This is one-tenth the strength of the U. S. P. Solution of Sodium Arsenate)

Sodii Boratis Compositus.....Made from Sodium Borate, Sodium Bicarbonate, Liquefied Phenol, Glycerin and Water

Sodii Phosphatis Compositus.....100 Gm. of Sodium Phosphate in 100 mils, with Citric Acid, Glycerin and Distilled Water

Zinci et Alumini Compositus.....Made from Zinc Sulphate, Aluminum Sulphate, Betanaphthol, Oil of Thyme, and Water

Zinci et Ferri Compositus.....Made from Zinc Sulphate, Ferrous Sulphate, Copper Sulphate, Betanaphthol, Oil of Thyme, Hypophosphorous Acid, and Water

LIQUORES, N. F. IV

2. Chemical Solutions (aqueous)

Liquor Alumini Acetatis	4.5 to 5.5 Gm. neutral Aluminum Acetate in 100 mils (Made from Lead Acetate, Aluminum Sulphate and Water)
Alumini Acetico-Tartratis	Made from Ammonium Alum, Monohydrated Sodium Carbonate, Glacial Acetic Acid, Tartaric Acid and Water
Alumini Subacetatis	7.5 to 8 per cent. Basic Aluminum Acetate (Made from Aluminum Sulphate, Acetic Acid, Precipitated Calcium Carbonate and Water)
Ammonii Citratis	About 14.5 per cent. Ammonium Citrate (Made from Citric Acid, Ammonia Water and Distilled Water)
Arsenicalis, Clemens	Arsenic in combination, corresponding to about 1 per cent. of As_2O_3 (Made from Arsenic Trioxide, Potassium Bicarbonate, Bromine and Water)
Auri et Arseni Bromidi	Made from Arsenic Trioxide, Bromauric Acid, Bromine, and Water
Calcis Sulphuratæ	Made from Calcium Oxide, Sublimed Sulphur, and Water
Chlori Compositus	0.35 Gm. of available chlorine in 100 mils (Made from Potassium Chlorate, Hydrochloric Acid, and Distilled Water)
Ferri Acetatis	About 31 per cent. Anhydrous Ferric Acetate corresponding to about 7.5 per cent. of Iron (Made from Solution of Ferric Sulphate, Glacial Acetic Acid, Ammonia Water and Distilled Water)
Ferri Albuminati	Made from Egg Albumen, Solution of Ferric Oxychloride, Sodium Citrate, Aromatic Elixir, Alcohol, and Distilled Water
Ferri Citratis	Ferric Citrate, corresponding to not less than 7.25 per cent. of Iron (Made from Solution of Ferric Sulphate, Citric Acid, Ammonia Water and Water)
Ferri Nitratis	Ferric Nitrate, corresponding to not less than 1.3 per cent. of Iron (Made from Solution of Ferric Sulphate, Ammonia Water, Nitric Acid and Distilled Water)
Ferri Oxychloridi	Made from Solution of Ferric Chloride, Ammonia Water, Glycerin, Hydrochloric Acid and Distilled Water
Ferri Oxysulphatis	Made from Ferrous Sulphate, Nitric Acid and Distilled Water
Ferri Peptonati	Made from Egg Albumen, Pepsin, Hydrochloric Acid, Sodium Citrate, Solution of Ferric Oxychloride, Alcohol, Syrup, Glycerin, Oil of Orange, Acetic Ether, Vanillin, Sodium Hydroxide and Distilled Water
Ferri Peptonati et Mangani	Made from the same ingredients as Solution of Iron Peptonate but with the addition of Soluble Manganese Citrate
Ferri Protochloridi	Made from Iron (Metallic), Hydrochloric Acid, Glycerin, and Distilled Water, with Diluted Hypophosphorous Acid as a preservative
Ferri Salicylatis	Made from Sodium Salicylate, Tincture of Ferric Citro-Chloride, Ammonium Carbonate, Citric Acid, Methyl Salicylate, Glycerin and Distilled Water
Hydrargyri Nitratis	From 58 to 62 per cent. Anhydrous Mercuric Nitrate and about 11 per cent. free Nitric Acid (Made from Red Mercuric Oxide, Nitric Acid, and Distilled Water
Phosphatum Acidus	Made from Precipitated Calcium Carbonate, Magnesium Carbonate, Phosphoric Acid and Distilled Water
Phosphatum Compositus	Made from Precipitated Calcium Carbonate, Ferric Phosphate, Ammonium Phosphate, Potassium Bicarbonate, Sodium Bicarbonate, Citric Acid Glycerin, Phosphoric Acid, Orange Flower Water and Distilled Water
Potassæ Chlorinatæ	Made from Potassium Carbonate, Chlorinated Lime and Water
Sodii Citratis	About 2.5 per cent. Sodium Citrate (Made from Citric Acid, Sodium Bicarbonate, and Distilled Water)
Sodii Citro-Tartratis Effervescens	Made from Sodium Bicarbonate, Tartaric Acid, Citric Acid, Syrup of Citric Acid, and Distilled Water
Strychninæ Acetatis	0.178 Gm. of Strychnine in 100 mils, with Diluted Acetic Acid, Alcohol, Compound Tincture of Cardamom, and Distilled Water

The official solutions vary so greatly in their properties and method of preparation that no general formula or comments can be given here to aid the student in studying them individually, which would compare in value with the careful consideration that should be given each separate formula. These processes will be found under the head of the main constituents entering into them in Part III. For general manipulation of solutions, see page 211.

Table of Unofficial Solutions[1]

Title	Ingredients	Method of Preparation
Liquor Acidi Chromici. Br.	25 Gm. Chromic Anhydride; Distilled Water to make 100 mils	Dissolve
Adrenalini Hydrochloricus. Br.	1 Gm. Adrenalin; 5 mils Chloroform; 9 Gm. Sodium Chloride; 3 mils Diluted HCl; Distilled Water to make 1000 mils	Dissolve the Chloroform and Sodium Chloride in 900 mils of Distilled Water, add the Acid; then the Adrenalin, and enough Water to make 1000 mils
Atropinæ Sulphatis. Br.	1 Gm. Atropine Sulphate; Distilled Water to make 100 mils	Dissolve the Atropine Sulphate in enough recently boiled Distilled Water to make 100 mils. Prepare freshly as needed
Bismuthiet Ammonii Citratis. Br.	70 Gm. Bismuth Oxynitrate; 52 Gm. Citric Acid; Ammonia Water and Distilled Water enough to make 1000 mils	Mix the powdered Citric Acid and Bismuth Oxynitrate with 20 mils of Distilled Water Allow to stand, with occasional stirring, until a small portion is soluble in Ammonia Water, wash the precipitate with four successive portions of Distilled Water, 400 mils each, dissolve the moist magma in sufficient Ammonia Water and add Distilled Water to make 1000 mils
Calcis Chlorinatæ. Br.	100 Gm. Chlorinated Lime; 1000 mils Distilled Water	Mix, shake occasionally during three hours, and filter
Epispasticus. Br.	4 Gm. Cantharidin; 25 mils Castor Oil; 12 Gm. Rosin; Acetone enough to make 1000 mils	Dissolve
Ferri Perchloridi.Br.	250 mils Strong Solution of Ferric Chloride; Distilled Water to make 1000 mils	Mix them
Formaldehydi Saponatus	400 Gm. Soft Soap; 300 mils 90 per cent. Alcohol; 200 mils Solution of Formaldehyde; Distilled Water to make 1000 mils	Dissolve the Soap in the Alcohol, add the Solution of Formaldehyde, and enough Distilled Water to make 1000 mils
Hydrargyri Nitratis Acidus. Br.	120 Gm. Mercury; 150 mils Nitric Acid; 45 mils Distilled Water	Dissolve the Mercury in the mixed Acid and Water without heat, then evaporate by gentle heat to 360 Gm.
Hydrargyri Perchloridi. Br.	1 Gm. Mercuric Chloride; Distilled Water enough to make 1000 mils	Dissolve
Magnesii Bicarbonatis. Br.	40 Gm. Magnesium Sulphate; 50 Gm. Sodium Carbonate; Distilled Water enough to make about 400 mils	Add a solution of the Sodium Carbonate in 200 mils of Distilled Water, to a hot solution of the Magnesium Sulphate, in 200 mils of Distilled Water, boil the mixture until CO_2 is no longer evolved, collect and wash the precipitate, dissolve it in 400 mils Distilled Water, into which carbonic acid gas, under pressure, has been introduced, and store in tightly stoppered bottles
Morphinæ Acetatis. Br.	1 Gm. Morphine Acetate; 2 mils Diluted Acetic Acid; 25 mils 90 per cent. Alcohol; Distilled Water to make 100 mils	Mix the Diluted Acetic Acid with the Alcohol and an equal volume of Distilled Water; dissolve the Morphine Acetate in the liquid and add enough Distilled Water to make 100 mils
Morphinæ Hydrochloridi.Br.	1 Gm. Morphine Hydrochloride; 2 mils Diluted Hydrochloric Acid; 25 mils 90 per cent. Alcohol; Distilled Water to make 100 mils	Mix the Diluted Hydrochloric Acid with the Alcohol and an equal volume of Distilled Water; dissolve the Morphine Hydrochloride in the liquid and add enough Distilled Water to make 100 mils
Morphinæ Tartratis. Br.	1 Gm. Morphine Tartrate; 25 mils 90 per cent. Alcohol; Distilled Water to make 100 mils	Dissolve the Morphine Tartrate in the Alcohol, mixed with an equal volume of Distilled Water, and add enough Distilled Water to make 100 mils
Potassii Permanganatis. Br.	10 Gm. Potassium Permanganate; Distilled Water to make 1000 mils	Dissolve the Potassium Permanganate in enough Distilled Water to make 1000 mils
Sodii Silicatis. U. S. P. 1890	A nearly saturated solution	
Strychninæ Hydrochloridi. Br.	1 Gm. Strychnine Hydrochloride; 25 mils 90 per cent. Alcohol; Distilled Water to make 100 mils	Dissolve the Strychnine Hydrochloride in the Alcohol, mixed with an equal volume of Distilled Water and add sufficient Distilled Water to make 100 mils

[1] In this list are included a former preparation of the U. S. P. 1890, and the 1914 British Pharmacopœia solutions. The British Pharmacopœia formerly included, under the title of Liquor, preparations made by percolation and maceration, and more properly classed with concentrated tinctures or 50 per cent. fluidextracts, but these have all been omitted from the 1914 edition.

QUESTIONS ON WATERS AND SOLUTIONS

How may the various forms of official preparations be classified? (See page 302.)
What are the preparations known as waters?
What preparations are recognized as waters in French and German Pharmacopœias?
What various methods have been used for preparing official waters?
What are the advantages or disadvantages of the several processes?
How many waters are official in the U. S. P? How many in the N. F.?
For what are the medicated waters generally used?
How may medicated waters be made from volatile liquids?
How is a solution of a gas obtained? How many distilled waters are there?
Name the official waters made by simple solution.
How is chlorine water made? How is compound solution of chlorine made?
From what is aqua amygdalæ amaræ prepared, and of what strength is it?
What is the strength of aqua chloroformi? Of aqua creosoti? Of aqua phenolata? Of aqua ammoniæ? Of aqua ammoniæ fortior?
Are the volatile oils generally more soluble in hot or in cold water?
In the preparation of medicated waters, what is the object of passing the liquid through an absorbent powder?
What substance has most generally been used for the purpose?
What is an objection to its use? What other substances have been used?
Name the official waters made by filtration through an absorbent powder.
What solvent should be used for solutions of alkaloids or of silver nitrate?
What is the strength of the following waters: aqua anisi, aqua camphoræ, aqua cinnamomi, aqua fœniculi, aqua menthæ piperitæ, aqua menthæ viridis?
Of the various processes for preparing medicated waters, which is the best?
What precautions should be observed in preparing distilled waters to obtain them of the best quality?
How may a drug be prevented from being injured by heat during distillation?
In distilling rose water or orange flower water, is a naked fire or steam heat preferable, and why? How may distilled waters be preserved?
Is there any objection to the use of alcohol for the purpose?
What is the strength of orange flower water?
What is the strength of rose water?
Give an outline of the U. S. P. IX general process for aromatic waters.
Name the U. S. P. alternative processes for making aromatic waters.
Write out in full the Latin name of bitter almond water.
How does the U. S. P. bitter almond water differ in hydrocyanic acid content from the standard adopted by the International Protocol, 1906?
Give the formula and mode of preparing it. Of preparing aqua anisi.
How is orange flower water prepared?
How should stronger orange flower water and stronger rose water be preserved and why? What impurities must be absent?
Give the formula and mode of preparing camphor water.
How is chloroform water prepared? Why is an excess of chloroform maintained in the dispensing bottle?
Give the formula and mode of preparing cinnamon water. Creosote water.
How is distilled water prepared? Sterilized distilled water?
Why is freshly distilled water required for this product?
What kind of glass flasks should be used during the sterilization?
Give the formula and mode of preparing fennel water. Peppermint water.
How is hamamelis water prepared? What portion of the plant is directed?
How much alcohol should be present?
Write out in full the Latin name of peppermint water. Of spearmint water.
Give the formula and mode of preparing spearmint water.
How is rose water prepared and preserved? What impurities should be absent?
Give the formula for phenolated water of the N. F. What is its synonym?
What is aqua laurocerasi of the British Pharmacopœia? How much hydrocyanic acid should it contain? What alternative method for many aromatic waters is authorized by the British Pharmacopœia?
What are Liquores of the U. S. P.?
How many solutions are official in the U. S. P. ? How many in the N. F.?
Into what two classes are solutions divided?
Name some of the more important unofficial solutions.

CHAPTER XXII

AQUEOUS SOLUTIONS CONTAINING SWEET OR VISCID SUBSTANCES

Syrupi *Syrups Sirups*

Syrups are concentrated solutions of sugar in water or aqueous liquids. The liquids used sometimes contain acetic or other organic acids, and occasionally a small quantity of alcohol. When water *alone* is used in making the solution of sugar, the preparation is termed *syrup*, or *simple syrup*. When the water contains soluble principles from various medicinal substances, the syrup is called a *medicated* syrup. A *flavored* syrup is one which is not medicinal in its action, but which is made by the introduction of various aromatic or pleasantly flavored substances. Syrups are useful preparations, because their sweet taste facilitates administration, while the presence of a large percentage of sugar renders them permanent, if they are properly made.

Selection of the Sugar.—The sugar which should be used exclusively in making syrups is clearly defined by the Pharmacopœia. It is described as in white, dry, hard, distinctly crystalline granules, permanent in the air, odorless, having a purely sweet taste, and a neutral reaction. This description applies to that known commercially as "granulated," and the official tests prescribed should be carefully observed. (See Saccharum.) Sugar must be free from ultramarine, Prussian blue, and insoluble substances, the presence of impurities, particularly ultramarine, has been proved to interfere with the stability and quality of syrups. The direction that the sugar should be dry is all-important, because the permanency of syrups largely depends upon their containing the correct proportion of sugar and water. If an insufficient amount of sugar is present, the syrups will ferment; if they contain too much, crystallization of the excess takes place at first, while the subsequent growth of the crystals is accompanied by an abstraction of sugar from the liquid, and the result is such a weakening of the syrup that fermentation results, as in the first instance. *Damp sugar* should never be used unless the amount of moisture has been carefully ascertained, and an allowance made for it. A commercial sugar of exceptional purity and whiteness is now offered under the name "Druggists Dry Granular." The granular crystals are unusually large and perfect and are dry, with less tendency to become moist from atmospheric dampness than other sugars. It represents the crystallization from the first running of the filters in the sugar refinery and consequently produces a superior syrup, almost entirely free from yellowish tint, even when in large volume.

Preparation of Syrups.—Syrups are prepared in various ways, and the choice of the proper method must always depend upon the physical and chemical characteristics of the substances entering into the preparation. Five methods are officially recognized, which may

be summarized as follows: 1. By solution with heat. 2. By agitation without heat. 3. By the simple addition of a medicating liquid to syrup. 4. By digestion or maceration. 5. By percolation.

1. **By Solution with Heat.**—This is the usual method of making syrups when the valuable constituent is not volatile nor injured by heat, and when it is desirable to make the syrup rapidly. The sugar is usually dissolved in the water or aqueous solution and heated until solution is effected, skimmed, strained, and the proper quantity of water added to make the desired weight or measure. If the syrup is made from an infusion, a decoction, or an aqueous solution containing organic matter, it is usually proper to heat the syrup to the boiling point, in order to coagulate albuminous matter; this is separated subsequently by straining. If the albumin or other impurities were suffered to remain in the syrup, fermentation would probably be induced in warm weather. Saccharometers (see page 86) are very useful in making syrups by the hot process where the specific gravity of the finished syrup is known. The saccharometer may be floated in the syrup *while boiling*, and thus the exact degree of concentration determined without waiting to cool the syrup and having to heat it again subsequently to concentrate it further.

2. **By Agitation without Heat.**—This process is directed by the Pharmacopœia to be used in those cases where heat will cause the loss of valuable volatile constituents. The sugar should be added to the aqueous solution contained in a bottle of twice the size required for the syrup. This permits active agitation and rapid solution. A "five-pint," glass-stoppered tincture bottle is well adapted for the making of 1000 mils of syrup by this process. The stoppering of the bottle is important, as it prevents contamination and loss during the process. The bottle should be allowed to lie upon its side when not being agitated. If a large quantity of syrup is required, it may be advantageously made in a churn.

3. **By the Simple Addition of a Medicating Liquid to Syrup.**—This method is resorted to in those cases in which fluidextracts, tinctures, or other liquids are added to syrup in order to medicate it. Syrups made in this way usually show precipitates in time, owing to the fact that alcohol enters into most of the liquids thus used, and the resinous and oily substances dissolved by the alcohol often precipitate when mixed with the syrup, producing unsightly preparations. A modification of this process, which is frequently adopted, consists of the mixing of the fluidextract or tincture with the water, allowing the mixture to stand to permit the separation of insoluble constituents, filtering, and then dissolving the sugar in the filtrate.

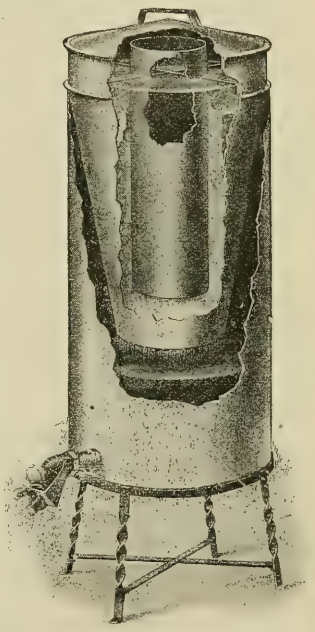
4. **By Maceration or Digestion.**—This method is not recommended as either accurate or efficient. A solution of a comparatively insoluble substance, like tolu or senna, as was directed in the U. S. P. 1880, can always be effected in a more rapid and thorough manner by dissolving the substance in alcohol, suspending the resinous tincture in a mixture of absorbent powder and water, filtering, and dissolving sugar in the filtrate, as in the U. S. P. process (9th Revision).

5. **Percolation in Making Syrups.**—This method originated with Orynski, and is conducted as follows: Into the lower orifice of an ordinary percolator is introduced a small piece of sponge or purified

cotton; the sugar (granulated) is then poured in, and upon this the water, the apparatus being arranged as is usual in the process of percolation. The percolator may be covered loosely, and the operation will proceed without further attention, the syrup coming through drop by drop. If it should be necessary to use crushed sugar, the percolator must be corked at the lower orifice, and the sugar and water introduced and allowed to macerate until the former has dissolved down to *half its bulk*, when the cork may be removed and the liquid allowed to drop. If, after the liquid has all passed, there remains a quantity of undissolved sugar in the percolator, enough percolate may be poured back to dissolve it, afterwards adding sufficient water to secure the required measure.

To be successful in using this process, care in several particulars must be exercised: 1. The percolator used should be cylindrical or semicylindrical, and cone-shaped as it nears the lower orifice. 2. The sugar must be coarse, else it will form into a compact mass, which the liquid cannot permeate. 3. The sponge or purified cotton must be introduced with care. If pressed in too tightly, it will effectually stop the process; if inserted too loosely, the liquid will pass too rapidly, and will, in consequence, be weak and turbid (from imperfect filtration); it should be inserted completely within the neck of the percolator, as a protruding end, inside the percolator, up through the sugar, will permit the last portions of water to pass out at the lower orifice without dissolving all of the sugar.

Fig. 419



Hardesty syrup percolator

The process of percolation has been applied on a commercial scale for the making of syrup for wholesale distribution or for use at the soda fountain. The Hensel or Hardesty Syrup Percolator, used in this way for making syrup in large quantities (see Fig. 419), consists of a galvanized-iron syrup reservoir with a spigot, and an inner vessel, conical in shape, for the sugar, fitting tightly inside of the reservoir and perforated to form a diaphragm, the perforations being covered with a straining medium. A smaller galvanized-iron water cylinder fits inside of the sugar vessel and is perforated to permit the water to mix with the sugar and form syrup. If sufficient sugar and water are kept in the several vessels, the action of the percolator is automatic, and brilliantly clear, filtered syrup, saturated at the prevailing temperature, collects in the outer vessel and may be drawn from the spigot as desired.

Preservation of Syrups.—Syrups should not be made in larger quantities than can be used within a few months, except in those cases where special facilities can be employed for their preservation. A low temperature is the best preservative for syrups; concentration

without supersaturation is also a condition favorable to preservation. The addition of such substances as benzoates, boric acid, salicylic acid, alcohol, fluorides, calcium sulphite, etc., to prevent the fermentation of syrups, is not recommended, for if used in sufficient quantity to act as preservatives they communicate their own flavor to the syrup or are otherwise objectionable. The practice of restoring syrups which have been spoiled through fermentation by heating them and "working them over" is a reprehensible one. The practice of good pharmacy demands the possession of sufficient moral courage to find a place for fermented syrups where they will do the least harm—*i.e.*, in the sink and sewer pipe.

A simple and practical method of preserving syrups, which is very effective, is as follows: A number of bottles are provided holding not more than a pint each, even when the quantity of syrup is large; the bottles are thoroughly cleaned, and kept hot by immersion in boiling water until ready for use; a sufficient number of good corks, which have been thoroughly soaked in hot water, and of the proper size for the bottles, should be at hand. The syrup should be heated to the boiling point (strained, if necessary, and reheated), and poured into the hot bottles until they are filled to the brim. The corks are inserted by forcibly pressing them into the necks of the bottles, thereby displacing a small portion of the syrup, and are tied down with twine in the usual manner. Then, while the necks of the bottles are still hot (and before the syrup can contract in volume through cooling) they are dipped into melted sealing-wax contained in a suitable vessel. By this method the organisms which produce fermentation are destroyed by the heat, and no air, carrying new contamination, can find its way to the syrup, as the bottles are hermetically sealed. Fruit juices may be preserved in this way.

The National Formulary recommends that syrups be preserved in well-dried bottles, preferably those which have been sterilized. These bottles should not hold more than is likely to be required during four to six weeks and should be completely filled, carefully stoppered, and stored in a cool, dark place.

Official Syrups.—There are *twenty-two* syrups official in the U. S. P. IX and *forty-four* in the N. F. IV. Of this number, *thirty* are made by the *simple addition of medicating liquid or solids to syrup*, *twenty-one* by *agitation of the sugar with the medicating liquid without heat*, and *fifteen* by *solution with heat*. The alternative process of percolation is permitted by the Pharmacopœia in *seven* syrups.

Syrups of the U. S. P. IX, arranged in Classes according to the Methods employed in their Preparation

Title and Method of Preparation	Sub-Classes	Ingredients
Simple Addition of Medicating Liquid or Solid to Syrup		
Syrupus Acidi Hydriodici	Simple admixture	(Containing from 1.3 Gm. to 1.45 Gm. of HI in 100 mils) 125 mils Diluted Hydriodic Acid; 300 mils Distilled Water; 575 mils Syrup
Acidi Citrici	From tincture and citric acid	10 Gm. Citric Acid; 10 mils Distilled Water; 10 mils Tincture of Lemon Peel; Syrup, enough to make 1000 mils
Lactucarii	From tincture	100 mils Tincture of Lactucarium; 1 Gm. Citric Acid; 50 mils Orange Flower Water; 200 mils Glycerin; Syrup, enough to make 1000 mils
Rhei Aromaticus	From aromatic tincture	150 mils Aromatic Tincture of Rhubarb; 1 Gm. Potassium Carbonate; Syrup, enough to make 1000 mils
Rhei	From fluidextract	100 mils Fluidextract of Rhubarb; 4 mils Spirit of Cinnamon; 10 Gm. Potassium Carbonate; 50 mils Water; Syrup, enough to make 1000 mils
Senegæ	" "	200 mils Fluidextract of Senega; Syrup, enough to make 1000 mils
Sennæ	" "	250 mils Fluidextract of Senna; 5 mils Oil of Coriander; Syrup, enough to make 1000 mils
Sarsaparillæ Compositus	From fluidextracts and aromatics	200 mils Fluidextract of Sarsaparilla; 15 mils Fluidextract of Glycyrrhiza; 15 mils Fluidextract of Senna; 0.2 mil each of Oil of Sassafras, Oil of Anise, and Methyl Salicylate; 19.4 mils Alcohol; Syrup, enough to make 1000 mils
Scillæ Compositus	From fluidextracts with antimony and potassium tartrate	80 mils Fluidextract of Squill; 80 mils Fluidextract of Senega; 2 Gm. Antimony and Potassium Tartrate; 10 mils Distilled Water; Syrup, enough to make 1000 mils
Agitation of Sugar with Medicating Liquid without Heat		
Syrupus Aurantii Florum	Simple solution or percolation	850 Gm. Sugar; Orange Flower Water, enough to make 1000 mils
Hypophosphitum	Simple solution or admixture	45 Gm. Calcium Hypophosphite; 15 Gm. Potassium Hypophosphite; 15 Gm. Sodium Hypophosphite; 2 mils Diluted Hypophosphorous Acid; 50 mils Glycerin; 600 Gm. Sugar; Distilled Water, enough to make 1000 mils
Picis Liquidæ	Thorough mixing of medication; magnesium carbonate and water, then filtration and solution of sugar in filtrate; percolation of sugar recommended	5 Gm. Tar; 50 mils Alcohol; 10 Gm. Magnesium Carbonate; 850 Gm. Sugar; Water, enough to make 1000 mils
Pruni Virginianæ	From cold percolation with glycerin and water menstruum; percolation of sugar recommended	150 Gm. Ground Wild Cherry Bark; 50 mils Glycerin; 800 Gm. Sugar; Water, enough to make 1000 mils
Calcii Lactophosphatis	Solution involving chemical reaction	60 mils Lactic Acid; 36 mils Phosphoric Acid; 50 mils Orange Flower Water; 25 Gm. Precipitated Calcium Carbonate; 650 Gm. Sugar; 50 mils Glycerin; Distilled Water, enough to make 1000 mils
Aurantii	From tincture	50 mils Tincture of Sweet Orange Peel; 5 Gm. Citric Acid; 15 Gm. Purified Talc; 820 Gm. Sugar; Distilled Water, enough to make 1000 mils
Ipecacuanhæ	From fluidextract; percolation recommended	70 mils Fluidextract of Ipecac; 10 mils Acetic Acid; 100 mils Glycerin; 700 Gm. Sugar; Water, enough to make 1000 mils
Solution with Heat		
Syrupus	Simple solution or percolation	850 Gm. Sugar; Distilled Water, enough to make 1000 mils
Acaciæ	Simple solution, heating for 15 minutes at 100° C., and preservation in sterilized bottles	100 Gm. Acacia; 800 Gm. Sugar; Distilled Water enough to make 1000 mils

Official Syrups—*Continued*

Title and Method of Preparation	Sub-Classes	Ingredients
Syrupus Scillæ	Containing acetic acid	450 mils Vinegar of Squill; 800 Gm. Sugar; Water enough to make 1000 mils
Ferri Iodidi	Solution involving chemical action, preserved by sugar	(Containing from 4.75 to 5.25 per cent. of FeI_2) 12.5 Gm. Iron Wire; 41.5 Gm. Iodine; 20 mils Diluted Hypophosphorus Acid; 575 Gm. Sugar; Distilled Water, enough to make 1000 Gm.
Tolutanus	Thorough mixing of tincture, magnesium carbonate, and water, then filtration and solution of sugar in filtrate; percolation of sugar recommended	50 mils Tincture of Tolu; 10 Gm. Magnesium Carbonate; 820 Gm. of Sugar; Water, enough to make 1000 mils
Zingiberis	Thorough mixing of fluidextract, magnesium carbonate, and water, then filtration and solution of sugar in filtrate; percolation of sugar recommended	30 mils Fluidextract of Ginger; 10 Gm. Magnesium Carbonate; 820 Gm. Sugar; 20 mils Alcohol; Water, enough to make 1000 mils

Syrups of the N. F. IV, arranged in Classes according to the Methods employed in their Preparation

Title and Method of Preparation	Sub-Classes	Ingredients
Simple Addition of Medicating Liquid or Solid to Syrup		
Syrupus Ammonii Hypophosphitis	Solution of chemical with flavor	35 Gm. Ammonium Hypophosphite; 2 mils Diluted Hypophosphorous Acid; 100 mils Distilled Water; 100 mils Glycerin; 2 mils Compound Spirit of Vanillin; Syrup, enough to make 1000 mils
Bromidorum	Solution of chemicals with color and flavor	80 Gm. each Potassium and Sodium Bromide; 50 Gm. Ammonium Bromide; 25 Gm. Calcium Bromide; 8 Gm. Lithium Bromide; 32 mils Tincture of Vanilla; 16 mils Compound Tincture of Cudbear; 450 mils Compound Syrup of Sarsaparilla; Syrup, enough to make 1000 mils
Codeinæ	Simple solution of alkaloid with heat	0.2 Gm. Codeine Sulphate; Syrup, enough to make 100 mils
Ferri Protochloridi	Simple admixture	50 mils Solution of Ferrous Chloride; 125 mils Glycerin; 125 mils Orange Flower Water; Syrup, enough to make 1000 mils
Morphinæ et Acaciæ	Solution of alkaloid with flavor	0.55 Gm. Morphine Hydrochloride; 0.5 mil Oil of Sassafras; Syrup of Acacia, enough to make 1000 mils
Phosphatum Compositus	Simple admixture	500 mils Compound Solution of Phosphates; 334 mils Syrup; 150 mils Glycerin; 16 mils Tincture of Cudbear
Phosphatum cum Quinina et Strychnina	Solution of alkaloids in glycerin, then simple admixture	4.4 Gm. Quinine Hydrochloride; 0.14 Gm. Strychnine Nitrate; 500 mils Compound Solution of Phosphates; 150 mils Glycerin; Syrup, enough to make 1000 mils
Pini Strobi Compositus cum Morphina	Solution of alkaloid	0.4 Gm. Morphine Sulphate; 1000 mils Compound Syrup of White Pine
Quinidinæ	Admixture without solution	33 Gm. Quinidine; 0.2 mil Oil of Orange; Syrup, enough to make 1000 mils
Calcii Hydrochlorophosphatis	Calcium phosphate solution with just sufficient HCl and then the addition of flavor and syrup	17.5 Gm. Precipitated Calcium Phosphate; 20 mils Tincture of Lemon Peel; Hydrochloric Acid; Water, and Syrup, each, enough to make 1000 mils
Ferri Lactophosphatis	Solution of ferrous lactate with the aid of H_3PO_4 and then the addition of sugar and syrup	17.5 Gm. Ferrous Lactate; 17.5 mils Phosphoric Acid; 80 Gm. Sugar; 50 mils Distilled Water; Syrup, enough to make 1000 mils

N. F. Syrups—*Continued*

Title and Method of Preparation	Sub-Classes	Ingredients
Syrupus Calcii Lactophosphatis et Ferri	Hot solution of chemicals, syrup added	8.5 Gm. Ferrous Lactate; 8.5 Gm. Potassium Citrate; 62.5 mils Water; Syrup of Calcium Lactophosphate, enough to make 1000 mils
Ferri Quininæ et Strychninæ Phosphatum	Hot solution of chemicals, glycerin and syrup added	20 Gm. Ferric Phosphate; 26 Gm. Quinine; 0.2 Gm. Strychnine; 50 mils Phosphoric Acid; 100 mils Glycerin; 50 mils Water; Syrup, enough to make 1000 mils
Ferri Saccharati Solubilis	Simple solution with heat, syrup added	415 Gm. Saccharated Ferric Oxide; 320 mils Syrup; Water, enough to make 1000 mils
Ipecacuanhæ et Opii	From tincture	85 mils Tincture of Ipecac and Opium; 4 mils Spirit of Cinnamon; 32 mils Cinnamon Water; Syrup, enough to make 1000 mils
Krameriæ	From fluidextract	450 mils Fluidextract of Krameria; Syrup, enough to make 1000 mils
Rubi	" "	250 mils Fluidextract of Rubus; Syrup, enough to make 1000 mils
Stillingiæ Compositus	" "	250 mils Compound Fluidextract of Stillingia; 100 mils Glycerin; 650 mils Syrup
Rhamni Catharticæ	From fluidextract with flavor	200 mils Fluidextract of Rhamnus Cathartica; 0.2 mil each, Oils of Fennel and Cinnamon; Syrup, enough to make 1000 mils
Sennæ Compositus	From fluidextracts with flavor	135 mils Fluidextract of Senna; 35 mils Fluidextract of Rhubarb; 35 mils Fluidextract of Frangula; 4 mils Methyl Salicylate; 65 mils Alcohol; Syrup, enough to make 1000 mils
Glycyrrhizæ	From fluidglycerate	250 mils Fluidglycerate of Glycyrrhiza; Syrup, enough to make 1000 mils
Agitation of Sugar with Medicating Liquid without Heat		
Syrupus Calcii et Sodii Hypophosphitum	Simple solution	35 Gm. each, Calcium and Sodium Hypophosphite; 1.5 mils Hypophosphorous Acid; 775 Gm. Sugar; Distilled Water, enough to make 1000 mils
Calcii Hypophosphitis	" "	35 Gm. Calcium Hypophosphite; 1.5 mils Hypophosphorous Acid; 775 Gm. Sugar; Distilled Water, enough to make 1000 mils
Hypophosphitum Compositus	Hot solution of ferric and manganese hypophosphites with the aid of sodium citrate; cold solution of other ingredients	35 Gm. Calcium Hypophosphite; 17.5 Gm. each, Potassium and Sodium Hypophosphite; 2.25 Gm. each, Ferric and Manganese Hypophosphite; 1.1 Gm. Quinine; 0.115 Gm. Strychnine; 3.75 Gm. Sodium Citrate; 15 mils Diluted Hypophosphorous Acid; 700 Gm. Sugar; 50 mils Glycerin; Water, enough to make 1000 mils
Sodii Hypophosphitis	Simple solution	35 Gm. Sodium Hypophosphite; 2 mils Hypophosphorous Acid; 800 Gm. Sugar; Distilled Water, enough to make 1000 mils
Calcii Iodidi	Solution of calcium iodide formed by chemical reaction; sugar dissolved in solution	76 Gm. Iodine; 28 Gm. Iron wire; 34 Gm. Precipitated Calcium Carbonate; 700 Gm. Sugar; Distilled Water and Syrup, each, enough to make 1000 mils
Ferri et Mangani Iodidi	Solution of iron and manganese iodide formed by chemical reaction; sugar dissolved in solution	81.5 Gm. Iodine; 28 Gm. Iron wire; 26.5 Gm. Manganese Sulphate; 35.6 Gm. Sodium Iodide; 800 Gm. Sugar; Diluted Alcohol and Distilled Water, each, enough to make 1000 mils
Allii	Maceration of garlic in diluted acetic acid, filtration, sugar dissolved in filtrate	200 Gm. Garlic; 800 Gm. Sugar; Diluted Acetic Acid, enough to make 1000 mils
Althææ	Maceration of althæa in weak alcohol, strain, sugar dissolved in strained liquid	50 Gm. Althæa; 30 mils Alcohol; 100 mils Glycerin; 700 Gm. Sugar; Water, enough to make 1000 mils
Asari Compositus	Maceration and percolation of drugs, the addition of other ingredients, and solution of sugar	62 Gm. Asarum; 1.5 Gm. Cochineal; 2.5 Gm. Potassium Carbonate; 200 mils Alcohol; 3 mils Fluidextract of Ipecac; 725 Gm. Sugar; Water, enough to make 1000 mils
Cinnamomi	Maceration and percolation of cinnamon and solution of sugar in percolate	100 Gm. Saigon Cinnamon; 50 mils Alcohol; 800 Gm. Sugar; Cinnamon Water, enough to make 1000 mils

N. F. Syrups—*Continued*

Title and Method of Preparation	Sub-Classes	Ingredients
Syrupus Papaveris	Exhaustion of drug by hot percolation, evaporation of percolate, filtration, and solution of sugar in liquid	100 Gm. Poppy Capsules; 850 Gm. Sugar; Water, enough to make 1000 mils
Pini Strobi Compositus	Maceration and percolation of mixed drugs and solution of sugar in percolate	85 Gm. White Pine Bark; 85 Gm. Wild Cherry; 10 Gm. Aralia; 10 Gm. Balsam Poplar Buds; 8 Gm. Sanguinaria; 7 Gm. Sassafras; 1 Gm. Cudbear; 6 mils Chloroform; 650 Gm. Sugar; 100 mils Glycerin; 0.2 mil Oil of Sassafras; Alcohol and Water, each, enough to make 1000 mils
Cimicifugæ Compositus	Maceration of wild cherry, fluidextracts added, filtration, and sugar dissolved in filtrate	40 mils Fluidextract of Cimicifuga; 20 mils each, Fluidextracts of Glycyrrhiza and Senega; 10 mils Fluidextract of Ipecac; 40 Gm. Wild Cherry; 15 Gm. Purified Talc; 650 Gm. Sugar; Water, enough to make 1000 mils
Rosæ	Fluidextract, acid and water mixture, filtration, and sugar dissolved in filtrate	125 mils Fluidextract of Rosæ; 10 mils Diluted Sulphuric Acid; 750 Gm. Sugar; Water, enough to make 1000 mils
Solution of Sugar with Heat		
Syrupus Ferri Hypophosphitis	Hot solution of ferric hypophosphite with the aid of potassium citrate; other ingredients added to solution	17.5 Gm. Ferric Hypophosphite; 25 Gm. Potassium Citrate; 850 Gm. Sugar; 90 mils Orange Flower Water; Distilled Water, enough to make 1000 mils
Mannæ	Hot solution of manna, filtration, and addition of alcohol and sugar	125 Gm. Manna; 775 Gm. Sugar; 65 mils Alcohol; Water, enough to make 1000 mils
Iodotannicus	Chemical combination between iodine and tannic acid and the solution of sugar in the liquid	2.7 Gm. Iodine; 5.4 Gm. Tannic Acid; 800 Gm. Sugar; Distilled Water, enough to make 1000 mils
Eriodictyi Aromaticus	Mix ingredients, filter, and dissolve sugar in the filtrate	32 mils Fluidextract of Eriodictyon; 25 mils solution of Potassium Hydroxide; 65 mils Compound Tincture of Cardamom; 0.5 mil Oil of Sassafras; 0.5 mil Oil of Lemon; 1 mil Oil of Cloves; 32 mils Alcohol; 800 Gm. Sugar; 5 Gm. Magnesium Carbonate; Water, enough to make 1000 mils
Ficorum Compositus	Digest figs, strain, evaporate strained liquid, dissolve sugar and add other ingredients	300 Gm. Figs; 200 mils Fluidextract of Senna; 100 mils Aromatic Fluidglycerate of Cascara Sagrada; 1 mil Oil of Fennel; 3 mils Spirit of Peppermint; 400 Gm. Sugar; Water, enough to make 1000 mils
Rubi Fructus	Crush and strain fruit, add sugar, heat mixture to boiling and bottle immediately	Fresh, Ripe Blackberries; Sugar, 2000 Gm. for each 1000 mils of expressed juice
Rubi Idæi	Crush fruit, allow to stand at 20° C. until juice mixes clear with half its volume of alcohol, strain, heat to boiling, filter, dissolve sugar in filtrate, and bottle	Fresh, Ripe Raspberries; Sugar, 200 Gm. for each 100 mils of filtered juice
Sanguinariæ	Macerate and percolate drug with acid menstruum and dissolve sugar in percolate	225 Gm. Sanguinaria; 125 mils Acetic Acid; 800 Gm. Sugar; Water, enough to make 1000 mils
Sennæ Aromaticus	Macerate and percolate mixed drugs, add fluidextract to percolate, and dissolve sugar in mixture	125 mils Fluidextract of Senna; 50 Gm. Jalap; 17.5 Gm. Rhubarb; 4 Gm. Saigon Cinnamon; 4 Gm. Clove; 2 Gm. Myristica; 1.5 mils Oil of Lemon; 500 Gm. Sugar; Diluted Alcohol, enough to make 1000 mils

Unofficial Syrups

Title	Ingredients	Method of Preparation
Syrupus Amygdalæ U. S. P. 1890 (Orgeat Syrup)	140 Gm. sweet almond; 40 Gm. bitter almond; 200 Gm. sugar; 100 mils orange flower water; 130 mils water; syrup, enough to make 1000 mils	Rub the blanched Almond with 100 Gm. of Sugar and 30 mils of Water to a paste, add the Orange Flower Water and 200 mils of Syrup and strain. To the residue add 100 mils of Water and again strain with strong pressure. Dissolve the remaining Sugar in the strained liquids and add enough Syrup to make 1000 mils
Aromaticus. Br.	250 mils tincture of orange; 250 mils cinnamon water; 500 mils syrup	Mix the Tincture and Cinnamon Water, add a little powdered talc, filter, and add the Syrup
Calcis U. S. P. VIII	65 Gm. lime; 350 Gm. sugar; water, enough to make 1000 mils	Slake the Lime with 35 mils of Water, with heat, and thoroughly mix the Sugar. Boil the mixture with 500 mils of Water for 5 minutes, constantly stirring, dilute with Water to 950 mils, filter and add enough Water through the filter to make 1000 mils
Cascaræ Aromaticus. Br.	400 mils liquid extract of cascara sagrada; 100 mils tincture of orange; 50 mils (90 per cent.) alcohol; 150 mils cinnamon water; syrup, enough to make 1000 mils	Mix them
Chloral. Br.	200 Gm. hydrated chloral; 200 mils distilled water; syrup, enough to make 1000 mils	Dissolve the Hydrated Chloral in the Distilled Water, and add enough Syrup to make 1000 mils
Ferri Phosphatis. Br.	8.6 Gm. iron wire; 62.5 mils phosphoric acid (66.3 per cent.); 700 mils syrup; distilled water, enough to make 1000 mils	Dissolve the Iron Wire in the Phosphoric Acid, previously diluted with an equal volume of Distilled Water, filter the Solution into the Syrup, and add Distilled Water to make 1000 mils
Glucosi. Br.	250 Gm. liquid glucose; 500 Gm. syrup	Mix with the aid of gentle heat
Limonis. Br.	20 Gm. fresh, grated lemon peel; 90 per cent. alcohol, a sufficient quantity; 500 mils lemon juice; 760 Gm. sugar	Macerate the Lemon Peel in 30 mils of Alcohol during seven days, and filter, adding Alcohol to make 40 mils. Dissolve the Sugar in the Lemon Juice with the aid of gentle heat, and when the syrup is cold add to it the Alcoholic solution and mix
Rhœados. Br.	260 Gm. red-poppy petals; 720 Gm. sugar; 50 mils 90 per cent. alcohol; distilled water, enough to make 1000 mils	Infuse the Red-Poppy Petals in 400 mils of heated Distilled Water, and afterwards allow it to stand for twelve hours, stirring frequently, strain, dissolve the Sugar in the liquid, add the Alcohol, and enough Distilled Water to make 1000 mils.

SYRUPUS. U.S. Syrup
[Sirup Simple Syrup]

	Metric	Old form
***Sugar,** in dry, crystalline granules.....	**850 Gm.**	**7 lbs. 1½ oz. av.**
Distilled Water, a sufficient quantity,		
To make.....	**1000 mils**	8 pints

Place at the bottom of a glass percolator of suitable size, a layer of purified cotton about one-half inch in thickness, well fitted to the sides of the percolator, and moisten it with a little distilled water. Introduce the sugar into the percolator, make its surface level without shaking or jarring, then carefully pour upon it 450 mils [old form 58 fl. oz.] of distilled water and regulate the flow of the liquid, if necessary, so that it passes out in rapid drops. Return the first portion of the percolate until it runs through clear and, when all of the liquid has passed, follow it by distilled water, added in portions, so that all of the sugar may be dissolved and the product measure 1000 mils [old form 8 pints]. Mix thoroughly.

Syrup may also be prepared in the following manner:

Dissolve the sugar with the aid of heat in 450 mils [old form 58 fl. oz.] of distilled water, raise the temperature to the boiling point, strain the liquid, and pass enough distilled water through the strainer to make the product, when cold, measure 1000 mils [old form 8 pints]. Mix thoroughly.

Syrup thus prepared has a specific gravity of about 1.313 at 25° C. (77° F.).

U. S. P. and N. F. Preparations.—Elixir Aromaticum, U. S. and Compound Elixirs, Syrups and other preparations.

SYRUPUS ACACIÆ. U. S. Syrup of Acacia

[Syr. Acac.]

	Metric	Old form
*Acacia, in selected pieces	100 Gm.	3 oz. av. 148 gr.
Sugar	800 Gm.	26 oz. av. 309 gr.
Distilled Water, a sufficient quantity,		
To make	1000 mils	2 pints

Place the acacia in an enamelled or porcelain dish, add 430 mils [old form 13½ fl. oz.] of distilled water, and stir occasionally until the acacia is dissolved; then, having added the sugar, place the dish on a water bath and apply heat, gradually increasing the temperature until the water in the water bath boils. Maintain this temperature for fifteen minutes, and stir the syrup from time to time until the sugar is dissolved. Strain the Syrup while hot, add sufficient distilled water, recently boiled, to make the product measure 1000 mils [old form 2 pints] and transfer it, while yet hot, into small bottles which have been rinsed with boiling water and heated in an oven at 160° C. (320° F.) for from fifteen to thirty minutes. Close the bottles tightly with rubber stoppers which have been just previously boiled in water for thirty minutes and cap them with paper.

N. F. Preparation.—Syrupus Morphinæ et Acaciæ.

SYRUPUS ACIDI CITRICI. U. S. Syrup of Citric Acid

[Syr. Acid. Cit.]

	Metric	Old form
*Citric Acid	10 Gm.	146 gr.
Distilled Water	10 mils	2½ fl. dr.
Tincture of Lemon Peel	10 mils	2½ fl. dr.
Syrup, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the citric acid in the distilled water and add the solution to 950 mils [old form 30 fl. oz.] of syrup, mixing it well. Then add the tincture of lemon peel, shake the mixture, and add enough syrup to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly and preserve it in containers which have been previously washed with boiling water.

This preparation must not be dispensed unless it is free from moulds and fermentation products.

N. F. Preparations.—Liquor Magnesii Citratis Effervescens; Liquor Sodii Citro-Tartratis Effervescens.

SYRUPUS ACIDI HYDRIODICI. U. S. Syrup of Hydriodic Acid
[Syr. Acid. Hydriod.]

One hundred mils of Syrup of Hydriodic Acid contains not less than 1.3 Gm. nor more than 1.45 Gm. of HI (127.93).

	Metric	Old form
*Diluted Hydriodic Acid	125 mils	4 fl. oz.
Distilled Water	300 mils	9 fl. oz. 288 min.
Syrup	575 mils	18 fl. oz. 192 min.
To make	1000 mils	2 pints

Mix them.

(For tests and comments, see Part III.)

SYRUPUS AURANTII. U. S. Syrup of Orange
[Syr. Aurant.]

	Metric	Old form
*Tincture of Sweet Orange Peel	50 mils	1 fl. oz. 288 min.
Citric Acid	5 Gm.	73 gr.
Purified Talc	15 Gm.	219 gr.
Sugar	820 Gm.	27 oz. av. 163 gr.
Distilled Water, a sufficient quantity,		
To make	1000 mils	2 pints

Triturate the purified talc in a mortar with the tincture, add gradually 400 mils [old form 12 fl. oz. 384 minims] of distilled water, filter, and add sufficient distilled water through the filter to obtain 450 mils [old form 14½ fl. oz.] of filtrate; in this filtrate dissolve the citric acid and sugar by agitation without heat, and add sufficient distilled water to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly.

SYRUPUS AURANTII FLORUM. U. S. Syrup of Orange Flowers
[Syr. Aurant. Flor.]

	Metric	Old form
*Sugar	850 Gm.	28 oz. av. 164 gr.
Orange Flower Water, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the sugar in 450 mils [old form 14½ fl. oz.] of orange flower water by agitation, without heat, add enough orange flower water to make the product measure 1000 mils [old form 2 pints], mix thoroughly and strain.

Syrup of Orange Flowers may also be made in the following manner:

Prepare a percolator in the manner described under *Syrupus*. Pour 450 mils [old form 14½ fl. oz.] of orange flower water upon the sugar, return the first portions of the percolate until it runs through clear and, when all of the liquid has passed, follow it by orange flower water, until the sugar is all dissolved and the product measures 1000 mils [old form 2 pints]. Mix thoroughly.

SYRUPUS CALCII LACTOPHOSPHATIS. U. S. Syrup of Calcium Lactophosphate

[Syr. Calc. Lactophos.]

	Metric	Old form
*Precipitated Calcium Carbonate	25 Gm.	365 gr.
Lactic Acid	60 mils	1 fl. oz. 442 min.
Phosphoric Acid	36 mils	1 fl. oz. 73 min.
Stronger Orange Flower Water	50 mils	1 fl. oz. 288 min.
Sugar	650 Gm.	21 oz. av. 305 gr.
Glycerin	50 mils	1 fl. oz. 288 min.
Distilled Water, a sufficient quantity,		
To make	1000 mils	2 pints

To the lactic acid, mixed with 100 mils [old form 3 fl. oz. 96 minims] of distilled water, gradually add the calcium carbonate, stirring until solution is effected. Then add the phosphoric acid, previously diluted with 50 mils [old form 1 fl. oz. 288 minims] of distilled water, and stir until the precipitate first formed is dissolved. Add 100 mils [old form 3 fl. oz. 96 minims] of distilled water, filter the solution, mix the stronger orange flower water with the filtrate, add the glycerin, and dissolve the sugar in the mixed liquids by agitation; then add enough distilled water to make the product measure 1000 mils [old form 2 pints] and strain.

N. F. Preparations.—Elixir Cinchonæ Alkaloidorum, Ferri et Calcii Lactophosphatis; Syrupus Calcii Lactophosphatis et Ferri.

Average dose.—2½ fluidrachms (10 mils).

SYRUPUS FERRI IODIDI. U. S. Syrup of Ferrous Iodide

[Syr. Ferr. Iod. Ferri Iodidi Syrupus P. I.]

A syrupy liquid containing not less than 4.75 per cent. nor more than 5.25 per cent. of FeI_2 (309.68). Preserve it in completely filled, tightly-stoppered bottles.

	Metric	Old form
*Iron, in the form of fine, bright wire and cut into small pieces	12.5 Gm.	247 gr.
Iodine	41.5 Gm.	1 oz. av. 380 gr.
Diluted Hypophosphorous Acid	20.0 mils	415 min.
Sugar	575.0 Gm.	25 oz. av. 400 gr.
Distilled Water, a sufficient quantity,		
To make	1000 Gm.	2 pints

Introduce the iron and iodine into a flask of thin glass, having a capacity of about 500 mils [old form 1 pint] and add to it 150 mils [old form 6½ fl. oz.] of distilled water. Shake the mixture occasionally, checking the reaction, if necessary, by placing the flask in cold water, and, when the solution has acquired a greenish color and has lost the odor of iodine, heat it to boiling and add at once 50 Gm. [old form 2 oz. av. 112 grains] of the sugar; when this has dissolved, filter the solution into the remainder of the sugar contained in a porcelain dish. Rinse the flask and iron wire with 125 mils [old form 5 fl. oz.] of distilled water and pass the washings through the filter into the sugar. Stir the mixture with a glass rod or a porcelain spatula, heating the liquid on a water bath until complete solution is effected, and, having passed the syrup through a clean muslin strainer into a tared bottle,

add the diluted hypophosphorous acid and sufficient distilled water to make the product *weigh* 1000 Gm. [old form, or *measure*, 2 pints].

(For tests and comments, see Part III.)

SYRUPUS HYPOPHOSPHITUM. U. S. **Syrup of Hypophosphites**
[Syr. Hypophos.]

	Metric	Old form
*Calcium Hypophosphite	45 Gm.	1 oz. av. 220 gr.
Potassium Hypophosphite	15 Gm.	219 gr.
Sodium Hypophosphite	15 Gm.	219 gr.
Diluted Hypophosphorous Acid	2 mils	31 min.
Glycerin	50 mils	1 fl. oz. 288 min.
Sugar	600 Gm.	20 oz. av. 13 gr.
Distilled Water, a sufficient quantity,		
To make	1000 mils	2 pints

Triturate the hypophosphites with 500 mils [old form 1 pint] of distilled water, until they are dissolved. Add the diluted hypophosphorous acid, filter the liquid and pass enough distilled water through the filter to make the filtrate measure 540 mils [old form 17 fl. oz. 134 minims]. To this add the glycerin and sugar, dissolve the latter by agitation without heat, and finally add enough distilled water, through the filter, to make the product measure 1000 mils [old form 2 pints]. Strain if necessary.

Average dose.—2½ fluidrachms (10 mils).

SYRUPUS IPECACUANHÆ. U. S. **Syrup of Ipecac**
[Syr. Ipecac.]

	Metric	Old form
*Fluidextract of Ipecac	70 mils	2 fl. oz. 115 min.
Acetic Acid	10 mils	154 min.
Glycerin	100 mils	3 fl. oz. 96 min.
Sugar	700 Gm.	23 oz. av. 160 gr.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Dilute the fluidextract of ipecac with 300 mils [old form 9 fl. oz. 288 minims] of water to which the acetic acid has previously been added, and mix them thoroughly by shaking and set the liquid aside in a cool place for twenty-four hours. Then filter, and pass enough water through the filter to make the filtrate measure 450 mils [old form 14½ fl. oz.]. To this filtrate add the glycerin, dissolve the sugar in the mixed liquids, and add enough water to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly and strain, if necessary.

Syrup of Ipecac may also be made in the following manner:

Prepare a percolator in the manner described under *Syrupus*. Mix the filtrate obtained as directed in the preceding formula with the glycerin, pour the mixture upon the sugar, return the first portions of the percolate until it runs through clear, and, when all the liquid has passed, follow it with water until the sugar is all dissolved and the product measures 1000 mils [old form 2 pints]. Mix thoroughly.

Average dose.— { Expectorant, 15 minims (1 mil).
Emetic, 4 fluidrachms (15 mils).

SYRUPUS LACTUCARII. U. S. Syrup of Lactucarium

[Syr. Lactucar.]

	Metric	Old form
*Tincture of Lactucarium	100 mils	3 fl. oz. 96 min.
Glycerin	200 mils	6 fl. oz. 192 min.
Citric Acid	1 Gm.	15 gr.
Orange Flower Water	50 mils	1 fl. oz. 288 min.
Syrup, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the tincture of lactucarium with the glycerin, add the orange flower water in which the citric acid has been previously dissolved, and filter, if necessary. Finally, add a sufficient quantity of syrup to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly.

Average dose.—2½ fluidrachms (10 mils).

SYRUPUS PICIS LIQUIDÆ. U. S. Syrup of Tar

[Syr. Pic. Liq.]

	Metric	Old form
*Tar	5 Gm.	73 gr.
Alcohol	50 mils	1 fl. oz. 288 min.
Magnesium Carbonate	10 Gm.	146 gr.
Sugar	850 Gm.	28 oz. av. 164 gr.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the tar in the alcohol, add the magnesium carbonate and 50 Gm. [old form 1 oz. av. 293 grains] of sugar, and after thorough trituration add 410 mils [old form 13 fl. oz.] of water. Stir the mixture occasionally during two hours and then filter it, returning the filtrate to the filter until the liquid is clear.

Dissolve the remainder of the sugar in the clear filtrate obtained from the treatment of the tar, and strain the syrup, adding sufficient water through the strainer to make the product measure 1000 mils [old form 2 pints].

Syrup of Tar may also be made in the following manner:

Prepare a percolator in the manner described under *Syrupus*. Pour the clear filtered liquid obtained from the treatment of the tar as directed above upon the remainder of the sugar, return the first portions of the percolate until it runs through clear, and, when all the percolate has passed, follow it with water until the sugar is all dissolved and the product measures 1000 mils [old form 2 pints]. Mix thoroughly.

Average dose.—1 fluidrachm (4 mils).

SYRUPUS PRUNI VIRGINIANÆ. U. S. Syrup of Wild Cherry

[Syr. Prun. Virg.]

	Metric	Old form
***Wild Cherry Bark**, in No. 20 powder	150 Gm.	5 oz. av.
Sugar	800 Gm.	26 oz. av. 309 gr.
Glycerin	50 mils	1 fl. oz. 288 min.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the glycerin with 200 mils [old form 6 fl. oz. 192 minims] of water, moisten the wild cherry bark with 100 mils [old form 3 fl. oz. 96 minims] of this mixture, pack it firmly in a cylindrical percolator and pour the remaining 150 mils [old form 4 fl. oz. 384 minims] of the menstruum upon it. When the glycerin-water menstruum has disappeared from the surface of the drug, add sufficient water to saturate the powder and leave a stratum above it. Close the lower orifice, and, having closely covered the percolator, allow the drug to macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding water as a menstruum until the percolate measures 500 mils [old form 1 pint]. Dissolve the sugar in the percolate by agitation without heat, strain and pass enough water through the strainer to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly.

Syrup of Wild Cherry may also be made in the following manner: Prepare a percolator in the manner described under *Syrupus*. Pour the percolate obtained as directed in the preceding formula upon the sugar, return the first portions of the percolate until it runs through clear, and, when all the liquid has passed, follow it with water, until the sugar is all dissolved and the product measures 1000 mils [old form 2 pints]. Mix thoroughly.

This Syrup should be stored in non-metallic, tightly-closed containers, in a cool place, as it rapidly loses hydrocyanic acid even under the most favorable conditions.

Average dose.—1 fluidrachm (4 mils).

SYRUPUS RHEI U. S. Syrup of Rhubarb

[Syr. Rhei]

	Metric	Old form
***Fluidextract of Rhubarb**	100 mils	3 fl. oz. 96 min.
Spirit of Cinnamon	4 mils	1 fl. dr.
Potassium Carbonate	10 Gm.	146 gr.
Water	50 mils	1 fl. oz. 288 min.
Syrup, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the spirit of cinnamon with the fluidextract of rhubarb, add the potassium carbonate previously dissolved in the water, and gradually add this mixture to enough syrup to make the product measure 1000 mils [old form 2 pints].

Average dose.—2½ fluidrachms (10 mils).

SYRUPUS RHEI AROMATICUS. U. S. Aromatic Syrup of Rhubarb

[Syr. Rhei Arom. Spiced Syrup of Rhubarb]

	Metric	Old form
*Aromatic Tincture of Rhubarb	150 mils	4 fl. oz. 384 min.
Potassium Carbonate	1 Gm.	15 gr.
Syrup, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the potassium carbonate in the tincture and add this to sufficient syrup to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly.

Average dose.—2½ fluidrachms (10 mils).

SYRUPUS SARSAPARILLÆ COMPOSITUS. U. S. Compound Syrup of Sarsaparilla

[Syr. Sarsap. Co.]

	Metric	Old form
*Fluidextract of Sarsaparilla	200.0 mils	6 fl. oz. 192 min.
Fluidextract of Glycyrrhiza	15.0 mils	230 min.
Fluidextract of Senna	15.0 mils	230 min.
Oil of Sassafras	0.2 mil	3 min.
Oil of Anise	0.2 mil	3 min.
Methyl Salicylate	0.2 mil	3 min.
Alcohol	19.4 mils	298 min.
Syrup	750.0 mils	24 fl. oz.
To make about	1000 mils	2 pints

Mix the fluidextracts and add the alcohol, in which the methyl salicylate and the oils (equivalent to about *four drops* each) have been dissolved. Gradually add this solution to the syrup and mix thoroughly.

N. F. Preparation.—Syrupus Bromidorum.

Average dose.—4 fluidrachms (15 mils).

SYRUPUS SCILLÆ. U. S. Syrup of Squill

[Syr. Scill.]

	Metric	Old form
*Vinegar of Squill	450 mils	14 fl. oz. 192 min.
Sugar	800 Gm.	26 oz. av. 309 gr.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the sugar in the vinegar of squill with the aid of a gentle heat, then strain the syrup, and, when the liquid is cold, add enough water, through the strainer, to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly.

Average dose.—30 minims (2 mils).

SYRUPUS SCILLÆ COMPOSITUS. U. S. Compound Syrup of Squill

[Syr. Scill. Co. Hive Syrup Coxe's Hive Syrup]

	Metric	Old form
*Fluidextract of Squill	80 mils	2 fl. oz. 4 ½ fl. dr.
Fluidextract of Senega	80 mils	2 fl. oz. 4 ½ fl. dr.
Antimony and Potassium Tartrate	2 Gm.	29 gr.
Distilled Water	10 mils	2½ fl. dr.
Syrup, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the antimony and potassium tartrate in the distilled water with the aid of heat, add this solution to 750 mils [old form 24 fl. oz.] of syrup and mix thoroughly. Then gradually add the fluidextracts, previously mixed, and, finally, sufficient syrup to make the product measure 1000 mils [old form 2 pints].

Average dose.—30 minims (2 mils).

SYRUPUS SENEGÆ. U. S. Syrup of Senega

[Syr. Seneg.]

	Metric	Old form
*Fluidextract of Senega	200 mils	6 fl. oz. 192 min.
Syrup, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the fluidextract with sufficient syrup to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS SENNÆ. U. S. Syrup of Senna

[Syr. Senn.]

	Metric	Old form
*Fluidextract of Senna	250 mils	8 fl. oz.
Oil of Coriander	5 mils	77 min.
Syrup, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the oil of coriander with the fluidextract of senna and add sufficient syrup to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly.

Average dose.—1 fluidrachm (4 mils).

SYRUPUS TOLUTANUS. U. S. Syrup of Tolu

[Syr. Tolu.]

	Metric	Old form
*Tincture of Tolu	50 mils	1 fl. oz. 288 min.
Magnesium Carbonate	10 Gm.	146 gr.
Sugar	820 Gm.	27 oz. av. 163 gr.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Rub the tincture of tolu in a mortar with the magnesium carbonate and 60 Gm. [old form 2 oz. av.] of the sugar. Then gradually add

430 mils [old form 13½ fl. oz.] of water, with constant trituration, and filter. Dissolve the remainder of the sugar in the clear filtrate, with the aid of a gentle heat, strain the syrup while hot, and add sufficient water to make the product measure 1000 mils [old form 2 pints].

Syrup of Tolu may also be made in the following manner:

Prepare a percolator in the manner described under *Syrupus*. Pour the filtrate obtained as directed in the preceding formula upon the remainder of the sugar, return the first portions of the percolate until it runs through clear, and, when all of the liquid has passed, follow it with water, until all of the sugar is dissolved and the product measures 1000 mils [old form 2 pints]. Mix thoroughly.

This syrup is used mainly as a flavor and enters the following preparations:

U. S. P. Preparations.—Trochisci Ammonii Chloridi; Trochisci Cubebæ.

N. F. Preparations.—Emulsum Olei Morrhuæ cum Calcii Lactophosphate; Emulsum Olei Morrhuæ cum Calcii Phosphate; Emulsum Olei Morrhuæ cum Pruno Virginiana; Emulsum Olei Morrhuæ cum Vitello; Mistura Pectoralis, Stokes.

Average dose.—4 fluidrachms (15 mils).

SYRUPUS ZINGIBERIS. U. S. Syrup of Ginger

[Syr. Zingib.]

	Metric	Old form
*Fluidextract of Ginger	30 mils	461 min.
Alcohol	20 mils	307 min.
Magnesium Carbonate	10 Gm.	146 gr.
Sugar	820 Gm.	27 oz. av. 163 gr.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the fluidextract of ginger and the alcohol, then triturate the liquid in a mortar with the magnesium carbonate and 60 Gm. [old form 2 oz. av.] of the sugar. Then gradually add 430 mils [old form 13½ fl. oz.] of water, with constant trituration, and filter. Dissolve the remainder of the sugar in the clear filtrate, with the aid of a gentle heat, strain the syrup while hot, and add sufficient water to make the product measure 1000 mils [old form 2 pints].

Syrup of Ginger may also be made in the following manner:

Prepare a percolator in the manner described under *Syrupus*. Pour the filtrate obtained as directed in the preceding formula upon the remainder of the sugar, return the first portions of the percolate until it runs through clear, and, when all the liquid has passed, follow it with water, until all of the sugar is dissolved and the product measures 1000 mils [old form 2 pints]. Mix thoroughly.

Average dose.—4 fluidrachms (15 mils).

SYRUPUS ALLII. N. F. Syrup of Garlic

[Syr. Allii]

	Metric	Old form
Garlic, sliced and bruised	200 Gm.	6 oz. av. 296 gr.
Sugar	800 Gm.	26 oz. av. 309 gr.
Diluted Acetic Acid, a sufficient quantity,		
To make	1000 mils	2 pints

Macerate the garlic in 300 mils [o d form 9 fl. oz. 288 minims] of diluted acetic acid during four days, and express the liquid, avoiding the use of metallic utensils. Then mix the residue with 200 mils [old form 6 fl. oz. 192 minims] more of diluted acetic acid, and again express. Mix the expressed liquids, and filter. Pour the filtrate upon the sugar, contained in a suitable vessel, and agitate the mixture until the sugar is dissolved. Lastly, add sufficient diluted acetic acid to make the product measure 1000 mils [old form 2 pints] and mix thoroughly.

Average dose.—1 fluidrachm (4 mils).

SYRUPUS ALTHÆÆ. N. F. Syrup of Althæa

[Syr. Althæ.]

	Metric	Old form
Althæa, cut in small pieces	**50 Gm.**	1 oz. av. 293 gr.
Alcohol	**30 mils**	7 fl. dr. 41 min.
Glycerin	**100 mils**	3 fl. oz. 96 min.
Sugar	**700 Gm.**	23 oz. av. 160 gr.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Wash the althæa with cold water, then macerate it with 400 mils [old form 12 fl. oz. 384 minims] of water previously mixed with the alcohol, during three hours, at room temperature without stirring, and strain without expressing the residue. In the strained liquid dissolve the sugar by agitation, without heat, add the glycerin and sufficient water to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly.

Keep the syrup in well-stoppered, completely filled bottles, in a cool place.

Average dose.—1 fluidrachm (4 mils).

SYRUPUS AMMONII HYPOPHOSPHITIS. N. F. Syrup of Ammonium Hypophosphite

[Syr. Ammon. Hypophos.]

	Metric	Old form
Ammonium Hypophosphite	**35 Gm.**	1 oz. av. 74 gr.
Diluted Hypophosphorous Acid	**2 mils**	31 min.
Distilled Water	**100 mils**	3 fl. oz. 96 min.
Glycerin	**100 mils**	3 fl. oz. 96 min.
Compound Spirit of Vanillin	**2 mils**	31 min.
Syrup, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the ammonium hypophosphite in the distilled water, add the diluted hypophosphorous acid, filter, and then add the glycerin, compound spirit of vanillin and sufficient syrup to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS ASARI COMPOSITUS. N. F. Compound Syrup of Asarum

[Syr. Asar. Co. Compound Syrup of Canada Snake-root]

	Metric	Old form
Asarum, in No. 40 powder	62.0 Gm.	2 oz. av. 30 gr.
Alcohol	200.0 mils	6 fl. oz. 192 min.
Cochineal, in fine powder	1.5 Gm.	22 gr.
Potassium Carbonate	2.5 Gm.	36 gr.
Fluidextract of Ipecac	3.0 mils	46 min.
Sugar	725.0 Gm.	24 oz. av. 87 gr.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the asarum intimately with the cochineal and potassium carbonate, previously triturated together. Moisten the powder with a sufficient quantity of a menstruum prepared by mixing the alcohol with 375 mils [old form 12 fl. oz.] of water and allow the moistened drugs to macerate, in a covered vessel, for twenty-four hours. Then transfer them to a percolator, and pour on the remainder of the menstruum. Allow the percolation to proceed slowly, and when all of the menstruum has been added follow it with water, until the percolate measures 500 mils [old form 1 pint.] To this add the fluidextract of ipecac, and afterwards the sugar, and dissolve the latter by agitation. Finally, add sufficient water to make the syrup measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS BROMIDORUM. N. F. Syrup of the Bromides

[Syr. Bromidor.]

	Metric	Old form
Potassium Bromide	80 Gm.	2 oz. av. 293 gr.
Sodium Bromide	80 Gm.	2 oz. av. 293 gr.
Ammonium Bromide	50 Gm.	1 oz. av. 293 gr.
Calcium Bromide	25 Gm.	365 gr.
Lithium Bromide	8 Gm.	117 gr.
Tincture of Vanilla	32 mils	1 fl. oz. 12 min.
Compound Tincture of Cudbear	16 mils	246 min.
Compound Syrup of Sarsaparilla	450 mils	14 fl. oz. 192 min.
Syrup, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the bromides in the compound syrup of sarsaparilla and 400 mils [old form 12 fl. oz. 384 minims] of syrup; then add the tinctures, and sufficient syrup to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS CALCII ET SODII HYPOPHOSPHITUM. N. F. Syrup of Calcium and Sodium Hypophosphites

[Syr. Calc. et Sod. Hypophos.]

	Metric	Old form
Calcium Hypophosphite	35.0 Gm.	1 oz. av. 74 gr.
Sodium Hypophosphite	35.0 Gm.	1 oz. av. 74 gr.
Hypophosphorous Acid	1.5 mils	23 min.
Sugar	775.0 Gm.	25 oz. av. 380 gr.
Distilled Water, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the hypophosphites with the aid of the hypophosphorous acid in 500 mils [old form 1 pint] of distilled water, filter the solution, add the sugar to the filtrate and after this has been dissolved by agitation, add sufficient distilled water to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS CALCII HYDROCHLOROPHOSPHATIS. N. F. Syrup of Calcium Hydrochlorophosphate

[Syr. Calc. Hydrochlorophos. SYRUPUS CALCII CHLORHYDROPHOSPHATIS, N. F. III]

	Metric	Old form
Precipitated Calcium Phosphate	17.5 Gm.	255 gr.
Tincture of Lemon Peel	20.0 mils	307 min.
Hydrochloric Acid,		
Water,		
Syrup, each, a sufficient quantity,		
To make	1000 mils	2 pints

Triturate the precipitated calcium phosphate with 30 mils [old form 461 minims] of water, and dissolve it with the aid of hydrochloric acid, avoiding an excess. Then add the tincture of lemon peel, filter the liquid, and wash the filter with a mixture of 30 mils [old form 461 minims] each of water and of syrup. Lastly, add sufficient syrup to the filtrate to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS CALCII HYPOPHOSPHITIS. N. F. Syrup of Calcium Hypophosphite

[Syr. Calc. Hypophos.]

	Metric	Old form
Calcium Hypophosphite	35.0 Gm.	1 oz. av. 74 gr.
Hypophosphorous Acid	1.5 mils	23 min.
Sugar	775.0 Gm.	25 oz. av. 380 gr.
Distilled Water, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the calcium hypophosphite with the aid of the hypophosphorous acid in 500 mils [old form 1 pint] of distilled water, filter the solution, add the sugar to the filtrate, and after this has been dissolved by agitation, add sufficient distilled water to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS CALCII IODIDI. N. F. Syrup of Calcium Iodide

[Syr. Calc. Iodid.]

	Metric	Old form
Iodine	76 Gm.	2 oz. av. 235 gr.
Iron Wire, fine, bright, and finely cut	28 Gm.	409 gr.
Precipitated Calcium Carbonate	34 Gm.	1 oz. av. 59 gr.
Sugar	700 Gm.	23 oz. av. 160 gr.
Distilled Water,		
Syrup, each, a sufficient quantity,		
To make	1000 mils	2 pints

Add the iron wire to 57 Gm. [old form 1 oz. av. 395 gr.] of the iodine and 175 mils [old form 5 fl. oz. 288 minims] of distilled water, and apply a gentle heat, until the iodine is combined, and the liquid has acquired a greenish color. Filter the liquid through a small filter into a flask containing the remainder of the iodine, wash the filter with about 62 mils [old form 1 fl. oz. 472 minims] of distilled water and then warm the solution gently until the iodine is dissolved, taking care that no iodine is lost by volatilization. Heat to boiling 235 mils [old form 7 fl. oz. 250 minims] of distilled water in a capacious dish, and add to it alternately, in small portions, first the precipitated calcium carbonate, and then the solution of iron iodide, stirring briskly and waiting until the violence of the reaction moderates before adding a fresh portion. From time to time add a little distilled water to replace that lost by evaporation. When all of the iron solution and calcium carbonate have been added, continue heating the mixture until it commences to boil, then filter it through a wetted filter, and wash the filter with sufficient distilled water to make the product, when cold, measure 500 mils [old form 1 pint]. In this dissolve the sugar by agitation, then add sufficient syrup to make the product measure 1000 mils [old form 2 pints] and strain.

Average dose.—30 minims (2 mils).

SYRUPUS CALCII LACTOPHOSPHATIS ET FERRI. N. F. Syrup of Calcium Lactophosphate and Iron

[Syr. Calc. Lactophos. et Ferr. Syrupus Calcii Lactophosphatis cum Ferro, N. F. III]

	Metric	Old form
Ferrous Lactate	**8.5 Gm.**	124 gr.
Potassium Citrate	**8.5 Gm.**	124 gr.
Water	**62.5 mils**	2 fl. oz.
Syrup of Calcium Lactophosphate, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the ferrous lactate and potassium citrate in the water with the aid of heat, and add sufficient syrup of calcium lactophosphate to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS CIMICIFUGÆ COMPOSITUS. N. F. Compound Syrup of Cimicifuga

[Syr. Cimicif. Co.]

[Syrupus Actææ Compositus, N. F. III. Compound Syrup of Actæa]

	Metric	Old form
Fluidextract of Cimicifuga	**40 mils**	1 fl. oz. 134 min.
Fluidextract of Glycyrrhiza	**20 mils**	307 min.
Fluidextract of Senega	**20 mils**	307 min.
Fluidextract of Ipecac	**10 mils**	154 min.
Wild Cherry, in moderately fine powder	**40 Gm.**	1 oz. av. 147 gr.
Purified Talc	**15 Gm.**	219 gr.
Sugar	**650 Gm.**	21 oz. av. 305 gr.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the wild cherry with 375 mils [old form 12 fl. oz.] of water, and allow it to macerate during one hour. Then add to it the fluidextracts and the talc and stir or agitate the mixture frequently and thoroughly during about fifteen minutes. Transfer it to a wetted filter, and, when the liquid ceases to drop from the funnel, wash the contents of the filter with sufficient water to obtain 500 mils [old form 1 pint] of filtrate. Dissolve the sugar in this liquid by agitation, and add sufficient water to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS CINNAMOMI. N. F. Syrup of Cinnamon

[Syr. Cinnam.]

	Metric	Old form
Saigon Cinnamon, in No. 30 powder	100 Gm.	3 oz. av. 148 gr.
Alcohol	50 mils	1 fl. oz. 288 min.
Sugar	800 Gm.	26 oz. av. 309 gr.
Cinnamon Water, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the alcohol with 450 mils [old form 14 fl. oz. 192 minims] of cinnamon water, moisten the cinnamon with a sufficient quantity of this menstruum and allow it to macerate for two hours. Then transfer it to a small percolator, and percolate, in the usual manner, using first the remainder of the menstruum above directed, and afterwards, cinnamon water. Collect 480 mils [old form 15 fl. oz. 173 minims] of the percolate and dissolve the sugar in this, then add a sufficient quantity of cinnamon water to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS CODEINÆ. N. F. Syrup of Codeine

[Syr. Codein.]

	Metric	Old form
Codeine Sulphate	0.2 Gm.	29 grains
Syrup, a sufficient quantity,		
To make	100 mils	2 pints

Reduce the codeine sulphate to a fine powder and dissolve it in the syrup, which has been warmed.

Average dose.—1 fluidrachm (4 mils).

SYRUPUS ERIODICTYI AROMATICUS. N. F. Aromatic Syrup of Eriodictyon

[Syr. Eriodict. Arom. Aromatic Syrup of Yerba Santa Syrupus Corrigens]

	Metric	Old form
Fluidextract of Eriodictyon	32.0 mils	1 fl. oz. 12 min.
Solution of Potassium Hydroxide	25.0 mils	384 min.
Compound Tincture of Cardamom	65.0 mils	2 fl. oz. 38 min.
Oil of Sassafras	0.5 mil	8 min.
Oil of Lemon	0.5 mil	8 min.
Oil of Clove	1.0 mil	15 min.
Alcohol	32.0 mils	1 fl. oz. 12 min.
Sugar	800.0 Gm.	26 oz. av. 309 gr.
Magnesium Carbonate	5.0 Gm.	73 gr.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the oils in the alcohol, add the fluidextracts and the tincture, then the solution of potassium hydroxide and 325 mils [old form 10 fl. oz. 192 minims] of water. Shake the mixture thoroughly, add the magnesium carbonate, filter and add sufficient water through the filter to make the liquid measure 500 mils [old form 1 pint]. Pour this filtrate upon the sugar contained in a bottle, and dissolve it by placing the bottle in hot water, agitating the contents frequently. Lastly, cool the product and add sufficient water to make the Syrup measure 1000 mils [old form 2 pints].

Average dose.—2 fluidrachms (8 mils).

SYRUPUS FERRI ET MANGANI IODIDI. N. F. Syrup of Iron and Manganese Iodide

[Syr. Ferr. et Mangan. Iod.]

	Metric	Old form
Iodine	81.5 Gm.	2 oz. av. 315 gr.
Iron Wire, fine, bright, and finely cut	28.0 Gm.	409 gr.
Manganese Sulphate	26.5 Gm.	387 gr.
Sodium Iodide	35.6 Gm.	1 oz. av. 83 gr.
Sugar	800.0 Gm.	26 oz. av. 309 gr.
Diluted Alcohol,		
Distilled Water, each, a sufficient quantity,		
To make	1000 mils	2 pints

Add the iodine to the iron and 200 mils [old form 6 fl. oz. 192 minims] of distilled water in a flask, and prepare a solution of ferrous iodide, in the usual manner, aiding the process, if necessary, by heating the contents of the flask, at first gently, and finally to boiling. Filter the liquid through a small filter, directly upon the sugar contained in a suitable bottle graduated to 1000 mils [old form 2 pints] and rinse the flask and filter with two portions, of 20 mils [old form 307 minims] each, of distilled water, adding the rinsings to the filtrate in the bottle. Dissolve the manganese sulphate in 100 mils [old form 3 fl. oz. 96 minims] of distilled water, and the sodium iodide in 100 mils [old form 3 fl. oz. 96 minims] of diluted alcohol, mix the two solutions and filter the mixture, collecting the filtrate in the bottle which contains the sugar and the iron iodide solution. Wash the filter with 25 mils [old form 384 minims] of cold distilled water, receiving the washings in the same bottle. Agitate the mixture until the sugar has dissolved, then add sufficient distilled water to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—15 minims (1 mil).

SYRUPUS FERRI HYPOPHOSPHITIS. N. F. Syrup of Ferric Hypophosphite

[Syr. Ferr. Hypophos.]

	Metric	Old form
Ferric Hypophosphite	17.5 Gm.	255 gr.
Potassium Citrate	25.0 Gm.	365 gr.
Sugar	850.0 Gm.	28 oz. av. 164 gr.
Orange Flower Water	90.0 mils	2 fl. oz. 422 min.
Distilled Water, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the ferric hypophosphite and the potassium citrate in 225 mils [old form 7 fl. oz. 96 minims] of distilled water, with the aid of heat, and filter. Mix the filtrate with the orange flower water, add sufficient distilled water to make the solution measure 450 mils [old form 14 fl. oz. 192 minims] and dissolve the sugar in this liquid with the aid of heat. Finally add sufficient distilled water to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS FERRI LACTOPHOSPHATIS. N. F. Syrup of Iron Lactophosphate

[Syr. Ferr. Lactophos.]

	Metric	Old form
Ferrous Lactate	**17.5 Gm.**	255 gr.
Phosphoric Acid	**17.5 mils**	269 min.
Sugar	**80.0 Gm.**	2 oz. av. 293 gr.
Distilled Water	**50.0 mils**	1 fl. oz. 288 min.
Syrup, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the ferrous lactate in 50 mils [old form 1 fl. oz. 288 minims] of distilled water with the aid of the phosphoric acid, dissolve the sugar in the solution, and add sufficient syrup to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

SYRUPUS FERRI PROTOCHLORIDI. N. F. Syrup of Ferrous Chloride

[Syr. Ferr. Protochlor. Syrup of Protochloride of Iron]

	Metric	Old form
Solution of Ferrous Chloride	**50 mils**	1 fl. oz. 288 min.
Glycerin	**125 mils**	4 fl. oz.
Orange Flower Water	**125 mils**	4 fl. oz.
Syrup, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the solution of ferrous chloride with the glycerin and orange flower water, and add sufficient syrup to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS FERRI, QUININÆ ET STRYCHNINÆ PHOSPHATUM. N. F. Syrup of the Phosphates of Iron, Quinine, and Strychnine

(Replacing U. S. P. VIII)

[Syr. Ferr. Quin. et Strych. Phos. Easton's Syrup]

	Metric	Old form
Ferric Phosphate	**20.0 Gm.**	292 gr.
Quinine	**26.0 Gm.**	380 gr.
Strychnine	**0.2 Gm.**	2.9 gr.
Phosphoric Acid	**50.0 mils**	1 fl. oz. 288 min.
Glycerin	**100.0 mils**	3 fl. oz. 96 min.
Water	**50.0 mils**	1 fl. oz. 288 min.
Syrup, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the ferric phosphate in the water with the aid of heat, then add the phosphoric acid, the quinine and the strychnine, and stir until solution is effected. Filter the liquid into the glycerin, contained in a graduated bottle, add sufficient syrup to make the product measure 1000 mils [old form 2 pints] and mix thoroughly.

Average dose.—1 fluidrachm (4 mils).

SYRUPUS FERRI SACCHARATI SOLUBILIS. N. F. Syrup of Soluble Saccharated Iron

[**Syr. Ferr. Sacch. Sol.** Syrupus Ferri Oxydati Solubilis Syrup of Saccharated Oxide of Iron Syrup of Soluble Oxide of Iron]

	Metric	Old form
Saccharated Ferric Oxide	**415 Gm.**	13 oz. av. 373 gr.
Syrup	**320 mils**	10 fl. oz. 115 min.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the saccharated ferric oxide in 400 mils [old form 12 fl. oz. 384 minims] of water on a water bath, add the syrup and sufficient water to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS FICORUM COMPOSITUS. N. F. Compound Syrup of Figs

[**Syr. Ficor. Co.**]

	Metric	Old form
Figs, cut into small pieces	**300 Gm.**	10 oz. av. 6 gr.
Fluidextract of Senna	**200 mils**	6 fl. oz. 192 min.
Aromatic Fluidglycerate of Cascara Sagrada	**100 mils**	3 fl. oz. 96 min.
Oil of Fennel	**1 mil**	15 min.
Spirit of Peppermint	**3 mils**	46 min.
Sugar	**400 Gm.**	13 oz. av. 154 gr.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Add 1000 mils [old form 2 pints] of boiling water to the figs and digest the mixture at a gentle heat, during two hours, replacing the water from time to time as it evaporates, then strain with pressure and set the strained liquid aside. Again digest the residue with 500 mils [old form 1 pint] of boiling water for one hour, replacing the water as it evaporates, and then strain. Mix the strained liquids, evaporate the mixture to 400 mils [old form 12 fl. oz. 384 minims] and while warm dissolve the sugar in the liquid. When the solution is cold add it to a mixture of the fluidextract of senna, aromatic fluidglycerate of cascara sagrada, oil of fennel, and spirit of peppermint. Finally add sufficient water to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS GLYCYRRHIZÆ. N. F. Syrup of Glycyrrhiza

[**Syr. Glycyrrh.** Syrup of Licorice]

	Metric	Old form
Fluidglycerate of Glycyrrhiza	**250 mils**	8 fl. oz.
Syrup, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix.

Average dose.—2 fluidrachms (8 mils).

SYRUPUS HYPOPHOSPHITUM COMPOSITUS. N. F. Compound Syrup of Hypophosphites

(Replacing U. S. P. VIII)

[Syr. Hypophos. Co.]

	Metric	Old form
Calcium Hypophosphite	**35.000 Gm.**	1 oz. av. 74 gr.
Potassium Hypophosphite	**17.500 Gm.**	255 gr.
Sodium Hypophosphite	**17.500 Gm.**	255 gr.
Ferric Hypophosphite	**2.250 Gm.**	33 gr.
Manganese Hypophosphite	**2.250 Gm.**	33 gr.
Quinine	**1.100 Gm.**	16 gr.
Strychnine	**0.115 Gm.**	$1\frac{7}{10}$ gr.
Sodium Citrate	**3.750 Gm.**	55 gr.
Diluted Hypophosphorous Acid	**15.000 mils**	230 min.
Sugar	**700.000 Gm.**	23 oz. av. 160 gr.
Glycerin	**50.000 mils**	1 fl. oz. 288 min.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Rub the ferric and manganese hypophosphites with the sodium citrate, add 30 mils [old form 461 minims] of water and warm the mixture, with stirring, until a clear greenish solution is obtained. Dissolve the calcium, potassium and sodium hypophosphites in 450 mils [old form 14 fl. oz. 192 minims] of water, to which 5 mils [old form 77 minims] of diluted hypophosphorous acid has been added; then dissolve the quinine and strychnine in 30 mils [old form 461 minims] of water, and the glycerin, with the aid of 10 mils [old form 154 minims] of diluted hypophosphorous acid, mix the solutions, and dissolve the sugar in them by agitation. Finally add sufficient water to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—2 fluidrachms (8 mils).

SYRUPUS IODOTANNICUS. N. F. Syrup of Iodotannin

[Syr. Iodotan.]

	Metric	Old form
Iodine	**2.7 Gm.**	39 gr.
Tannic Acid	**5.4 Gm.**	79 gr.
Sugar	**800.0 Gm.**	26 oz. av. 309 gr.
Distilled Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Reduce the iodine to a powder, introduce it into a flask with the tannic acid and 450 mils [old form 14 fl. oz. 192 minims] of distilled water, and heat the mixture on a water bath, at a temperature not exceeding 50° C. (122° F.), agitating the flask from time to time, until a drop of the liquid ceases to give a blue coloration with starch T. S. Then add the sugar, and when this is dissolved remove the flask from the water bath, allow the syrup to cool, and finally add sufficient distilled water to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS IPECACUANHÆ ET OPII. N. F. Syrup of Ipecac and Opium

[Syr. Ipecac. et Opii. SYRUP OF DOVER'S POWDER]

	Metric	Old form
Tincture of Ipecac and Opium	**85 mils**	2 fl. oz. 346 min.
Spirit of Cinnamon	**4 mils**	1 fl. dr.
Cinnamon Water	**32 mils**	1 fl. oz. 12 min.
Syrup, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the tincture, spirit and water, then add sufficient syrup to make the product measure 1000 mils [old form 2 pints] and mix thoroughly.

Average dose.—1 fluidrachm (4 mils).

SYRUPUS KRAMERIÆ. N. F. Syrup of Krameria

(U. S. P. VIII)

[Syr. Kramer.]

	Metric	Old form
Fluidextract of Krameria	**450 mils**	14 fl. oz. 192 min.
Syrup, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix them.

Average dose.—1 fluidrachm (4 mils).

SYRUPUS MANNÆ. N. F. Syrup of Manna

[Syr. Mann.]

	Metric	Old form
Manna, in flakes	**125 Gm.**	4 oz. av. 76 gr.
Sugar	**775 Gm.**	25 oz. av. 380 gr.
Alcohol	**65 mils**	2 fl. oz. 38 min.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the manna in 400 mils [old form 12 fl. oz. 384 minims] of hot water, add the alcohol, set the liquid aside for twelve hours in a moderately warm place, and then filter it. Dissolve the sugar in the filtrate, with the aid of a gentle heat, allow the syrup to cool, and add sufficient water, passed through the filter previously used, to make the product measure 1000 mils [old form 2 pints].

Average dose.—2 fluidrachms (8 mils).

SYRUPUS MORPHINÆ ET ACACIÆ. N. F. Syrup of Morphine and Acacia

[Syr. Morph. et Acac. SYRUPUS PECTORALIS, N. F. III JACKSON'S PECTORAL SYRUP]

	Metric	Old form
Morphine Hydrochloride	**0.55 Gm.**	8 gr.
Oil of Sassafras	**0.50 mil**	8 min.
Syrup of Acacia, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the morphine hydrochloride in about 62 mils [old form 2 fl. oz.] of the syrup, add the oil of sassafras and sufficient syrup of acacia to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS PAPAVERIS. N. F. Syrup of Poppy
[Syr. Papaver.]

	Metric	Old form
Poppy Capsules, deprived of seeds and in a No. 20 powder	**100 Gm.**	3 oz. av. 148 gr.
Sugar	**850 Gm.**	28 oz. av. 164 gr.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Loosely pack the powder in a suitable metallic percolator and percolate it with boiling water until it is practically exhausted. Heat the percolate to boiling for two minutes, then concentrate it, on a water bath, to 450 mils [old form 14 fl. oz. 192 minims], filter and dissolve the sugar in the concentrated percolate. Finally add sufficient water to make the product measure 1000 mils [old form 2 pints], strain and bottle the syrup while yet warm. Preserve Syrup of Poppy in small, completely filled bottles in a cool place.

Average dose.—1 fluidrachm (4 mils).

SYRUPUS PHOSPHATUM COMPOSITUS. N. F. Compound Syrup of the Phosphates

[Syr. Phosphat. Co. Chemical Food]

	Metric	Old form
Compound Solution of Phosphates	**500 mils**	1 pint
Syrup	**334 mils**	10 fl. oz. 330 min.
Glycerin	**150 mils**	4 fl. oz. 384 min.
Tincture of Cudbear	**16 mils**	246 min.
To make	**1000 mils**	2 pints

Mix the tincture of cudbear with the glycerin and add the other ingredients.

Average dose.—1 fluidrachm (4 mils).

SYRUPUS PHOSPHATUM CUM QUININA ET STRYCHNINA. N. F.
Syrup of Phosphates with Quinine and Strychnine

[Syr. Phosphat. c. Quin. et Strych. Syrupus Hydrochlorophosphatum, N. F. III Compound Syrup of Hydrochlorophosphates]

	Metric	Old form
Quinine Hydrochloride	**4.40 Gm.**	64 gr.
Strychnine Nitrate	**0.14 Gm.**	2 gr.
Compound Solution of Phosphates	**500.00 mils**	1 pint
Glycerin	**150.00 mils**	4 fl. oz. 384 min.
Syrup, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the quinine and strychnine salts in the glycerin with the aid of heat and add the other ingredients.

Average dose.—1 fluidrachm (4 mils).

SYRUPUS PINI STROBI COMPOSITUS. N. F. Compound Syrup of White Pine

[Syr. Pin. Strob. Co.]

	Metric	Old form
White Pine Bark, in No. 30 powder	**85.0 Gm.**	2 oz. av. 366 gr.
Wild Cherry, in No. 30 powder	**85.0 Gm.**	2 oz. av. 366 gr.
Aralia, in No. 30 powder	**10.0 Gm.**	146 gr.
Balsam Poplar Buds, in No. 30 powder	**10.0 Gm.**	146 gr.
Sanguinaria, in No. 30 powder	**8.0 Gm.**	117 gr.
Sassafras, in No. 30 powder	**7.0 Gm.**	102 gr.
Cudbear	**1.0 Gm.**	15 gr.
Chloroform	**6.0 mils**	92 min.
Sugar	**650.0 Gm.**	21 oz. av. 305 gr.
Glycerin	**100.0 mils**	3 fl. oz. 96 min.
Oil of Sassafras	**0.2 mil**	3 min.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the vegetable drugs and moisten the powder with a sufficient quantity of a menstruum composed of the glycerin, 100 mils [old form 3 fl. oz. 96 minims] of alcohol, and 200 mils [old form 6 fl. oz. 192 minims] of water, pack it in a percolater, and macerate for twelve hours. Then continue the percolation, using first the remainder of the menstruum and then a mixture of one volume of alcohol and three volumes of water until the percolate measures 600 mils [old form 19 fl. oz. 96 minims]. In this percolate dissolve the sugar, add the chloroform and oil of sassafras and mix thoroughly. Finally add sufficient water to make the product measure 1000 mils [old form 2 pints] and strain.

N. F. Preparation.—Syrupus Pini Strobi Compositus cum Morphina.

Average dose.—1 fluidrachm (4 mils).

SYRUPUS PINI STROBI COMPOSITUS CUM MORPHINA. N. F. Compound Syrup of White Pine with Morphine

[Syr. Pin. Strob. c. Morph. Syrupus Pini Strobi Compositus, N. F. III]

	Metric	Old form
Morphine Sulphate	**0.4 Gm.**	$5\frac{1}{4}$ gr.
Compound Syrup of White Pine	**1000 mils**	2 pints

Dissolve the morphine sulphate in the compound syrup of white pine and mix well.

Average dose.—30 minims (2 mils).

SYRUPUS QUINIDINÆ. N. F. Syrup of Quinidine

[Syr. Quinid. Bitterless Syrup of Quinidine]

	Metric	Old form
Quinidine, in fine crystals	**33.0 Gm.**	1 oz. av. 44 gr.
Oil of Orange	**0.2 mil**	3 min.
Syrup, a sufficient quantity,		
To make	**1000 mils**	2 pints

Add the oil and the quinidine to 750 mils [old form 24 fl. oz.] of syrup, contained in a bottle, and shake the mixture thoroughly. Then add sufficient syrup to make the product measure 1000 mils [old form 2 pints]. Shake it well before dispensing.

Average dose.—1 fluidrachm (4 mils).

SYRUPUS RHAMNI CATHARTICÆ. N. F. Syrup of Rhamnus Cathartica

[Syr. Rham. Cathart. Syrup of Buckthorn Berries Syrupus Spinæ Cervinæ]

	Metric	Old form
Fluidextract of Rhamnus Cathartica	**200.0 mils**	6 fl. oz. 192 min.
Oil of Fennel	**0.2 mil**	3 min.
Oil of Cinnamon	**0.2 mil**	3 min.
Syrup, a sufficient quantity,		
To make	**1000 mils**	2 pints

Add the oils to the fluidextract and mix this with sufficient syrup to make the product measure 1000 mils [old form 2 pints].

Average dose.—2 fluidrachms (8 mils).

SYRUPUS ROSÆ. N. F. Syrup of Rose

(U. S. P. VIII)

[Syr. Ros.]

	Metric	Old form
Fluidextract of Rose	**125 mils**	4 fl. oz.
Diluted Sulphuric Acid	**10 mils**	154 min.
Sugar	**750 Gm.**	25 oz. av. 16 gr.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the fluidextract of rose and diluted sulphuric acid with 300 mils [old form 9 fl. oz. 288 minims] of water and allow the mixture to stand for two hours; then filter and add enough water through the filter to obtain 520 mils [old form 16 fl. oz. 307 minims] of filtrate. Dissolve the sugar in the filtrate by agitation and finally add sufficient water to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly.

SYRUPUS RUBI. N. F. Syrup of Rubus

(U. S. P. VIII)

[Syr. Rubi]

	Metric	Old form
Fluidextract of Rubus	**250 mils**	8 fl. oz.
Syrup, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix them.

Average dose.—1 fluidrachm (4 mils).

SYRUPUS RUBI FRUCTUS. N. F. Syrup of Blackberry Fruit

[Syr. Rubi Fruct.]

Fresh, Ripe Blackberries,
Sugar, each, a sufficient quantity.

Garble the blackberries, then wash the fruit in a colander with water, drain and crush to a pulp. Strain this pulp, with pressure, and to every

1000 mils [old form 2 pints] of expressed juice add 2000 Gm. [old form 66 oz. av. 334 grains] of sugar. Heat the mixture at once, with stirring, and when the sugar has dissolved continue the heat until the syrup just boils. Strain it while hot into suitable bottles which have been thoroughly cleaned and, just before filling, rinsed with boiling water, and, when the bottles are filled to the neck, immediately insert, to a point at least 5 mm. below the lip of the bottles well-fitting corks which have been soaked in boiling water. Finally seal the bottles with melted paraffin.

Keep Syrup of Blackberry Fruit in a cool and dark place.

N. F. Preparations.—Cordiale Rubi Fructus; Elixir Rubi Compositum.

SYRUPUS RUBI IDÆI. N. F. Syrup of Raspberry
[Syr. Rubi Id.]

Fresh, Ripe Raspberries, any convenient quantity,
Sugar, a sufficient quantity.

Garble the raspberries, wash them with water, drain, and reduce them to a pulp, and let this stand, at a temperature of about 20° C. (68° F.), until a small portion of the filtered juice produces a clear solution with half its volume of alcohol. Then separate the juice by straining with pressure, heat it just to the boiling point, remove the scum and filter while hot. Add 200 Gm. [old form 6 oz. av. 296 grains] of sugar to every 100 mils [old form 3 fl. oz. 96 minims] of filtered juice and agitate the mixture until the sugar is dissolved. Keep the product in well-stoppered bottles in a cool and dark place.

SYRUPUS SANGUINARIÆ. N. F. Syrup of Sanguinaria
[Syr. Sanguinar. Syrup of Bloodroot]

	Metric	Old form
Sanguinaria, in No. 20 powder	**225 Gm.**	7 oz. av. 224 gr.
Acetic Acid	**125 mils**	4 fl. oz.
Sugar	**800 Gm.**	26 oz. av. 309 gr.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the acetic acid with 375 mils [old form 12 fl. oz.] of water, moisten the sanguinaria with a sufficient quantity of this menstruum, and allow it to macerate for two hours. Then pack it in a glass percolator, and percolate in the usual manner, first with the remainder of the menstruum and afterwards with water until the percolate measures 750 mils [old form 24 fl. oz.] or until the sanguinaria is practically exhausted. Evaporate the percolate, at a moderate heat, to 480 mils [old form 15 fl. oz. 173 minims], filter, and dissolve the sugar in this filtrate, with the aid of a gentle heat. Finally add sufficient water to make the product measure 1000 mils [old form 2 pints].

Average dose.—30 minims (2 mils).

SYRUPUS SENNÆ AROMATICUS. N. F. Aromatic Syrup of Senna [Syr. Senn. Arom.]

	Metric	Old form
Fluidextract of Senna	125.0 mils	4 fl. oz.
Jalap, in No. 40 powder	50.0 Gm.	1 oz. av. 293 gr.
Rhubarb, in No. 40 powder	17.5 Gm.	255 gr.
Saigon Cinnamon, in No. 40 powder	4.0 Gm.	58 gr.
Clove, in No. 40 powder	4.0 Gm.	58 gr.
Myristica, in No. 40 powder	2.0 Gm.	29 gr.
Oil of Lemon	1.5 mils	23 min.
Sugar	500.0 Gm.	16 oz. av. 302 gr.
Diluted Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the drugs, add the oil of lemon, moisten with sufficient diluted alcohol and, after macerating for twenty-four hours, percolate in the usual manner, using diluted alcohol as the menstruum. Reserve the first 550 mils [old form 17 fl. oz. 288 minims] of the percolate, add the fluidextract of senna, and dissolve the sugar in the liquid with the aid of a gentle heat, but avoiding the loss of alcohol by evaporation. Allow the solution to cool, collect a further portion of the percolate, and add a sufficient quantity of it to the syrup to make the product measure 1000 mils [old form 2 pints].

Average dose.—2 fluidrachms (8 mils).

SYRUPUS SENNÆ COMPOSITUS. N. F. Compound Syrup of Senna [Syr. Senn. Co. [

	Metric	Old form
Fluidextract of Senna	135 mils	4 fl. oz. 154 min.
Fluidextract of Rhubarb	35 mils	1 fl. oz. 58 min.
Fluidextract of Frangula	35 mils	1 fl. oz. 58 min.
Methyl Salicylate	4 mils	1 fl. dr.
Alcohol	65 mils	2 fl. oz. 38 min.
Syrup, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the methyl salicylate in the alcohol, and add this to the mixed fluidextracts. Then add sufficient syrup to make the product measure 1000 mils [old form 2 pints] and mix thoroughly.

Average dose.—2 fluidrachms (8 mils).

SYRUPUS SODII HYPOPHOSPHITIS. N. F. Syrup of Sodium Hypophosphite

[Syr. Sod. Hypophos.]

	Metric	Old form
Sodium Hypophosphite	35 Gm.	1 oz. av. 74 gr.
Hypophosphorous Acid	2 mils	31 min.
Sugar	800 Gm.	26 oz. av. 309 gr.
Distilled Water, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the sodium hypophosphite in 450 mils [old form 14¼ fl. oz.] of distilled water, add the hypophosphorous acid and filter the solution. Dissolve the sugar in this liquid by agitation and add sufficient distilled water to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SYRUPUS STILLINGIÆ COMPOSITUS. N. F. Compound Syrup of Stillingia

[Syr. Stilling. Co.]

	Metric	Old form
Compound Fluidextract of Stillingia	**250 mils**	8 fl. oz.
Glycerin	**100 mils**	3 fl. oz. 96 min.
Syrup	**650 mils**	20 fl. oz. 384 min.
To make	**1000 mils**	2 pints

Mix the fluidextract with the glycerin, add the syrup and mix well.

Average dose.—1 fluidrachm (4 mils).

Mellita *Honeys*

Official honeys are thick liquid preparations closely allied to the syrups, differing merely in the use of honey as a base, instead of syrup. Their advantages over syrups are not very apparent, particularly since of late years the difficulty of obtaining pure honey has greatly increased. *Three* honeys are official in the U. S. P. IX and *two* in the N. F. IV. The National Formulary recognizes *one* additional preparation, under the title "Oxymel," which properly belongs to this class (see below).

Honeys of the U. S. P. IX

Title	Ingredients	Method of preparation
Mel	Commercial honey	A saccharine secretion deposited in the honeycomb by the bee, *Apis mellifera*, Linné (Fam. *Apidæ*)
Depuratum	Clarified honey	Heat a weighed quantity of Honey, mixed with 2 per cent. of paper-pulp, on a water bath, remove the scum, strain, add enough Distilled Water to replace that lost from evaporation, and mix with 5 per cent. of its weight of Glycerin
Rosæ	120 mils fluidextract of rose and enough clarified honey to make 1000 Gm.	Mix thoroughly

Honeys of the N. F. IV

Title	Ingredients	Method of preparation
Mel Rosæ et Sodii Boratis	10 Gm. Sodium Borate; 5 Gm. Glycerin; 85 Gm. Honey of Rose	Mix them
Sodii Boratis	10 Gm. Sodium Borate; 5 Gm. Glycerin; 85 Gm. Clarified Honey	Mix them
Oxymel Scillæ	50 Gm. Vinegar of Squill; 100 Gm. Clarified Honey	Mix in a tared, porcelain dish and evaporate on water bath to 100 Gm.

MEL DEPURATUM. U. S. Clarified Honey

[Mel Depurat.]

***Honey,** a convenient quantity
Distilled Water,
Glycerin, each, a sufficient quantity.

Weigh the honey in a tared dish, mix it intimately with two per cent. of paper pulp, which has been previously reduced to shreds, thoroughly washed and soaked in water, and then strongly expressed and again shredded. Then heat on a water bath at a temperature not exceeding 70° C. (158° F.), and carefully remove the scum which rises to the surface. Add enough distilled water to make up the loss incurred by evaporation, strain, and mix the strained liquid with five per cent. of its weight of glycerin.

Clarified Honey, diluted with twice its weight of water, has a specific gravity of not less than 1.095 at 25° C. (77° F.); in other respects it conforms to the test for purity under *Mel.*

U. S. P. Preparations.—Hydrargyrum cum Creta; Massa Ferri Carbonatis; Mel Rosæ.
N. F. Preparations.—Confectio Rosæ; Gargarisma Guaiaci Compositum; Mel Sodii Boratis; Mistura Guaiaci; Oxymel Scillæ; also as an excipient in pills.

MEL ROSÆ. U. S. Honey of Rose

	Metric	Old form
***Fluidextract of Rose**	**120 mils**	**5 fl. oz.**
Clarified Honey, a sufficient quantity,		
To make	**1000 Gm.**	**2 pints**

Mix the fluidextract of rose in a tared vessel with enough clarified honey to make the product *weigh* 1000 Gm. [old form, or *measure,* 2 pints].

U. S. P. Preparation.—Massa Hydrargyri.
N. F. Preparation.—Mel Rosæ et Sodii Boratis.

Average dose.—1 fluidrachm (4 mils).

MEL ROSÆ ET SODII BORATIS. N. F. Honey of Rose and Sodium Borate

[Mel Ros. et Sod. Bor. Honey of Rose with Borax]

	Metric	Old form
Sodium Borate, in fine powder	**10 Gm.**	175 gr.
Glycerin	**5 Gm.**	87½ gr.
Honey of Rose	**85 Gm.**	3 oz. av. 175 gr.
To make	**100 Gm.**	4 oz. av.

Mix the sodium borate with the glycerin, add the honey of rose, and stir until solution is effected.

MEL SODII BORATIS. N. F. Honey of Sodium Borate
[Mel Sod. Bor. MEL BORACIS HONEY AND BORAX]

	Metric	Old form
Sodium Borate, in fine powder	**10 Gm.**	175 gr.
Glycerin	**5 Gm.**	87½ gr.
Clarified Honey	**85 Gm.**	3 oz. av. 175 gr.
To make	**100 Gm.**	4 oz. av.

Mix the sodium borate with the glycerin, add the honey, and stir until solution is effected.

OXYMEL SCILLÆ. N. F. Oxymel of Squill
[Oxymel Scill.]

	Metric	Old form
Vinegar of Squill	**50 Gm.**	2 oz. av.
Clarified Honey	**100 Gm.**	4 oz. av.
To make	**100 Gm.**	4 oz. av.

Mix the honey and the vinegar of squill in a tared porcelain dish or enamelled iron vessel, and heat on a water bath until the mixture has been reduced to a weight of 100 Gm. [old form 4 oz. av.]. Then strain the preparation, allow it to cool, and transfer it to bottles, which should be well stoppered.

Average dose.—1 fluidrachm (4 mils).

Mucilagines *Mucilages*

The official mucilages are thick, viscid, adhesive liquids, produced by dissolving gum in water, or by extracting with water the mucilaginous principles from vegetable substances. There are *two* mucilages official in the U. S. P. IX and *two* in the N. F. IV. *Two* are made without the application of heat, and *two* with heat. The mucilages are all prone to decomposition, and should never be made in larger quantities than can be used immediately.

Mucilages of the U. S. P. IX and N. F. IV

Title	Ingredients		Method of preparation
Mucilago Acaciæ, U.S.P.	350 Gm. Acacia; Distilled Water, sufficient to make 1000 Gm.	Without heat	Wash the Acacia with cold water; then add enough warm Distilled Water to make the mixture weigh 1000 Gm.; agitate until dissolved, and strain
Sassafras Medullæ, N. F.	2 Gm. Sassafras Pith; Water, enough to make about 100 mils	Without heat	Macerate for three hours, and strain without expression
Chondri, N. F.	30 Gm. Chondrus; Water, sufficient to make 1000 mils	With heat	Wash Chondrus with cold Water, add 1000 mils of Water and heat on water bath for 15 minutes, with frequent stirring. Then strain with pressure and add Water through strainer to make 1000 mils
Tragacanthæ, U. S. P.	6 Gm. Tragacanth; 18 Gm. Glycerin; Water, sufficient to make 100 Gm.	With heat	Mix the Glycerin with 75 mils of Water, heat to boiling, add the Tragacanth, macerate for twenty-four hours, stirring occasionally. Then add enough Water to make the mixture weigh 100 Gm.; heat it until of uniform consistence and strain forcibly through muslin

Unofficial Mucilages

Title	Ingredients	Method of Preparation
Mucilago Gummi Indici, Br.	50 Gm. Indian Gum; 150 mils Distilled Water	Rapidly rinse the Indian Gum with a little water; then dissolve it in the Distilled Water in a closed vessel and strain. It should be recently prepared
Ulmi, U.S.P. VIII	6 Gm. Elm; Water, 100 mils	Digest the bruised Elm with the Water, on a water bath, in a covered vessel, during one hour, then strain

MUCILAGO ACACIÆ. U. S. Mucilage of Acacia [Mucil. Acac.]

	Metric	Old form
*Acacia, in small fragments	350 Gm.	1 oz. av. 175 gr.
Distilled Water, a sufficient quantity,		
To make	1000 Gm.	4 oz. av.

Place the acacia in a tared bottle or flask having a capacity not exceeding 1000 mils [old form 4 fl. oz.], wash the drug with cold water, allow it to drain, and then add enough warm distilled water to make the mixture weigh 1000 Gm. [old form 4 oz. av.]. Securely stopper the container, and agitate it from time to time until the acacia is dissolved. Strain the Mucilage and preserve it in small, well-filled bottles in a refrigerator or in a cool place. Mucilage of Acacia should be frequently made and must not be dispensed if it has become sour or moldy.

N. F. Preparations.—Mistura Copaibæ; Mistura Copaibæ et Opii.

Average dose.—4 fluidrachms (15 mils).

MUCILAGO TRAGACANTHÆ. U. S. Mucilage of Tragacanth [Mucil. Trag.]

	Metric	Old form
*Tragacanth	6 Gm.	105 gr.
Glycerin	18 Gm.	315 gr.
Water, a sufficient quantity,		
To make	100 Gm.	4 oz. av.

Mix the glycerin with 75 mils [old form 2½ fl. oz.] of water in a tared vessel, heat the mixture to boiling, remove the heat, add the tragacanth, and macerate during twenty-four hours, stirring occasionally. Then add enough water to make the mixture weigh 100 Gm. [old form 4 fl. oz.], beat it until of a uniform consistence, and strain it forcibly through muslin.

It is used as an excipient in troches and pills.

MUCILAGO CHONDRI. N. F. Mucilage of Chondrus

[Mucil. Chondr. Mucilage of Irish Moss]

	Metric	Old form
Chondrus	30 Gm.	1 oz. av.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Wash the chondrus with cold water, place it in a suitable vessel, add 1000 mils [old form 2 pints] of water and heat it, on a water bath, during fifteen minutes, frequently stirring. Then strain it through muslin with pressure and pass sufficient water through the strainer to make the product, when cold, measure 1000 mils [old form 2 pints].

MUCILAGO SASSAFRAS MEDULLÆ. N. F. Mucilage of Sassafras Pith

(U. S. P. VIII)

[Mucil. Sassaf. Medul.]

	Metric	Old form
Sassafras Pith	2 Gm.	37 gr.
Water	100 mils	4 fl. oz.
To make about	100 mils	4 fl. oz.

Macerate the sassafras pith in the water during three hours, and strain without expression. This preparation should not be dispensed unless it has been recently prepared.

Average dose.—4 fluidrachms (15 mils).

Emulsa *Emulsions*

The U. S. Pharmacopœia of 1890 introduced emulsions as a separate class of preparations; formerly they were included under the general heading of Misturæ. The necessity for differentiation in nomenclature, as preparations of established merit multiply, is apparent. Emulsions are aqueous liquids in which oleaginous substances are suspended by the intervention of gum, yolk of egg, or other viscid matter. Their method of preparation is fully considered under Part V, Extemporaneous liquids. There are *four* emulsions official in the U. S. P. IX and *eight* in the N. F. IV.

Emulsions of the U. S. P. IX

Title	Ingredients	Method of preparation
Emulsum Amygdalæ	60 Gm. Sweet Almond; 10 Gm. Acacia; 30 Gm. Sugar; Water, enough to make 1000 mils	Blanch the Almonds, add the Acacia and Sugar, and beat thoroughly in mortar. Then rub with 900 mils Water until uniform, strain, and add enough Water to make 1000 mils
Asafœtidæ	40 Gm. Asafetida; Water, enough to make 1000 mils	Rub the Asafetida in a mortar with 900 mils Water until uniform, strain and add Water to make 1000 mils
Olei Morrhuæ	500 mils Cod Liver Oil; 125 Gm. Acacia; 100 mils Syrup; 4 mils Methyl Salicylate; Water, enough to make 1000 mils	Mix the Acacia with the Cod Liver Oil in a dry mortar, add at once 250 mils of Water and triturate until emulsified. Then add Methyl Salicylate, Syrup, and enough Water to make 1000 mils
Olei Terebinthinæ	15 mils Rectified Oil of Turpentine; 5 mils Expressed Oil of Almond; 25 mils Syrup; 15 Gm. Acacia; Water, enough to make 100 mils	Mix the Oil of Turpentine and Oil of Almond with the Acacia in a dry bottle, then add 30 mils of Water, shake vigorously, then add the Syrup and enough Water to make 100 mils

Emulsions of the N. F. IV

Title	Ingredients	Method of preparation
Emulsum Olei Morrhuæ cum Calcii Lactophosphate	500 mils Cod Liver Oil; 50 Gm. Calcium Lactophosphate; 16 mils Lactic Acid; 125 Gm. Acacia; 100 mils Syrup of Tolu; Flavoring and Water, each, enough to make 1000 mils	Mix the Acacia and Oil in a dry mortar, add 250 mils of Water and triturate until emulsified. Dissolve the Calcium Lactophosphate in 65 mils of Water, with the Acid, and add this Solution, the flavoring selected, the Syrup of Tolu and enough Water to make 1000 mils
Olei Morrhuæ cum Calcii Phosphate	500 mils Cod Liver Oil; 125 Gm. Acacia; 35 Gm. Precipitated Calcium Phosphate; 100 mils Syrup of Tolu; Flavoring and Water, each, enough to make 1000 mils	Mix the Acacia and Oil in a dry mortar, add 250 mils of Water and triturate until emulsified. Then add the flavoring selected, the Syrup of Tolu and Calcium Phosphate, and enough Water to make 1000 mils
Olei Morrhuæ cum Hypophosphitibus	500 mils Cod Liver Oil; 125 Gm. Acacia; 10 Gm. Calcium Hypophosphite; 5 Gm. Potassium Hypophosphite; 5 Gm. Sodium Hypophosphite; 100 mils Syrup; Flavoring and Water, each, enough to make 1000 mils	Mix the Acacia and Oil in a dry mortar, add 250 mils of Water, triturate until emulsified and add the flavoring selected. Dissolve the Hypophosphites in 100 mils of Water, add the Syrup, slowly incorporate with the emulsion and add enough Water to make 1000 mils
Olei Morrhuæ cum Malto	300 mils Cod Liver Oil; 3 Gm. Tragacanth; 150 mils Water; Extract of Malt, enough to make 1000 mils	Mix the Oil and Tragacanth in a bottle, add the Water and shake the mixture until homogeneous. Then add the Extract in portions, shaking after each addition, to make 100 mils
Olei Morrhuæ cum Pruno Virginiana	500 mils Cod Liver Oil; 125 Gm. Acacia; 65 mils Fluidextract of Wild Cherry; 100 mils Syrup of Tolu; Flavoring and Water, each, enough to make 1000 mils	Mix the Acacia and Oil in a dry mortar, add 250 mils of Water and triturate until emulsified. Then gradually incorporate the Fluidextract, Syrup, flavoring selected, and enough Water to make 1000 mils
Olei Morrhuæ cum Vitello	500 mils Cod Liver Oil; 175 mils Glycerite of Yolk of Egg; 100 mils Syrup of Tolu; Flavoring and Water, each, enough to make 1000 mils	Emulsify the Oil in a mortar with the aid of the Glycerite of Egg, then add the Syrup, the flavor selected and enough Water to make 1000 mils
Olei Ricini	35 mils Castor Oil; 9 Gm. Acacia; 2.5 mils Tincture of Vanilla; 20 mils Syrup; Water, enough to make 100 mils	Mix the Acacia and Oil in a dry mortar, add 18 mils of Water and triturate until emulsified. Then gradually incorporate the Syrup and Tincture, and enough Water to make 100 mils
Petrolati	225 Gm. Petrolatum; 225 mils Expressed Oil of Almond; 125 Gm. Acacia; 100 mils Syrup; 15 mils Tincture of Lemon Peel; Water, enough to make 1000 mils	Mix the melted Petrolatum and Oil of Almond with the Acacia in a warm, dry mortar, add 250 mils of warm Water and triturate until emulsified. Then add the mixed Syrup and Tincture and enough Water to make 1000 mils

Unofficial Emulsions

Title	Ingredients	Method of preparation
Emulsum Ammoniaci. U. S. P. 1890	40 Gm. Ammoniac, with enough Water to make 1000 mils	Rub the Ammoniac, in a warmed mortar, with 900 mils of Water, added very gradually, until emulsified, strain, and add enough Water to make 1000 mils
Chloroformi, U. S. P. VIII	40 mils Chloroform; 60 mils Expressed Oil of Almond; 10 Gm. Tragacanth; Water, enough to make 1000 mils	Mix the Chloroform and Tragacanth thoroughly in a dry bottle, add 250 mils of Water, and incorporate by vigorous shaking. Then add the Oil of Almond in portions, shaking the emulsion after each addition, and afterward enough Water, added in the same manner, to make 1000 mils

EMULSUM AMYGDALÆ. U. S. Emulsion of Almond

[Emul. Amygd. MILK OF ALMOND]

	Metric	Old form
***Sweet Almond**	**60 Gm.**	219 gr.
Acacia, in fine powder	**10 Gm.**	37 gr.
Sugar	**30 Gm.**	109 gr.
Water, a sufficient quantity,		
To make	**1000 mils**	8 fl. oz.

Having blanched the almonds, add the acacia and sugar, and beat them in a mortar, until they are thoroughly mixed. Then rub the mass with 900 mils [old form 7 fl. oz.] of water, at first very gradually added, until a uniform mixture results. Strain this into a graduated vessel, and wash the mortar and strainer with enough water to make the product measure 1000 mils [old form 8 fl. oz.]. Mix the whole thoroughly. This preparation must not be dispensed unless it has been recently prepared.

Average dose.—4 fluidounces (120 mils).

EMULSUM ASAFŒTIDÆ. U. S. Emulsion of Asafetida

[Emuls. Asafœt. Milk of Asafetida]

	Metric	Old form
*Asafetida, in tears or selected masses	40 Gm.	146 gr.
Water, a sufficient quantity,		
To make	1000 mils	8 fl. oz.

Rub the asafetida in a mortar, with 900 mils [old form 7 fl. oz.] of water, at first very gradually added, until a uniform emulsion results. Then strain the mixture into a graduated vessel, and rinse the mortar and strainer with enough water to make the product measure 1000 mils [old form 8 fl. oz.]. Mix the whole thoroughly.

Average dose.—4 fluidrachms (15 mils).

EMULSUM OLEI MORRHUÆ. U. S. Emulsion of Cod Liver Oil

[Emuls. Ol. Morrh.]

	Metric	Old form
*Cod Liver Oil	500 mils	1 pint
Acacia, in fine powder	125 Gm.	4 oz. av. 76 gr.
Syrup	100 mils	3 fl. oz. 96 min.
Methyl Salicylate	4 mils	1 fl. dr.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Thoroughly mix the acacia with the cod liver oil in a dry mortar or other suitable vessel, then add at once 250 mils [old form 8 fl. oz.] of water, and complete the emulsification by trituration or by the aid of a suitable mechanical device. When a thick, white, homogeneous mixture is obtained, add the methyl salicylate and the syrup with sufficient water to make the product measure 1000 mils [old form 2 pints] and mix thoroughly.

Note.—The methyl salicylate may be replaced by a suitable quantity of any other flavoring.

Average dose.—4 fluidrachms (15 mils).

EMULSUM OLEI TEREBINTHINÆ. U. S. Emulsion of Oil of Turpentine

[Emuls. Ol. Tereb.]

	Metric	Old form
*Rectified Oil of Turpentine	15 mils	1 fl. oz. 96 min.
Expressed Oil of Almond	5 mils	192 min.
Syrup	25 mils	2 fl. oz.
Acacia, in fine powder	15 Gm.	1 oz. av. 110 gr.
Water, a sufficient quantity,		
To make	100 mils	8 fl. oz.

Introduce the acacia into a perfectly dry bottle of sufficient capacity, add the rectified oil of turpentine and the expressed oil of almond and shake the bottle thoroughly. Then add 30 mils [old form 2¾ fl. oz.] of water and incorporate it by vigorous shaking. When the oil has been completely emulsified, add first the syrup, in several portions, shaking after each addition, and then enough water, in divided portions, shaking after each addition, to make the product measure 100 mils [old form 8 fl. oz.].

Average dose.—½ fluidrachm (2 mils).

Flavors for Emulsions

The National Formulary suggests the following combinations as flavors for the N. F. Emulsions. Any other suitable flavor may, however, be used, the one considered most suitable being selected by the prescriber or dispenser. The quantities given below are intended for 1000 mils [old form 2 pints] of finished product:

		Metric	Old form
a.	Oil of Betula	4 mils	1 fl. dr.
b.	Oil of Betula	2 mils	31 min.
	Oil of Sassafras	2 mils	31 min.
c.	Compound Spirit of Orange	1.5 mils	23 min.
d.	Oil of Betula	2.00 mils	31 min.
	Oil of Bitter Almond	0.25 mil	4 min.
	Oil of Coriander	0.25 mil	4 min.
e.	Oil of Betula	1.50 mils	23 min.
	Oil of Sassafras	1.50 mils	23 min.
	Oil of Bitter Almond	0.25 mil	4 min.
f.	Oil of Betula	2.5 mils	38 min.
	Oil of Bitter Almond	2.5 mils	38 min.

EMULSUM OLEI MORRHUÆ CUM CALCII LACTOPHOSPHATE.

N. F. **Emulsion of Cod Liver Oil with Calcium Lactophosphate**

[Emul. Ol. Morrh. c. Calc. Lactophos.]

	Metric	Old form
Cod Liver Oil	500 mils	1 pint
Calcium Lactophosphate	50 Gm.	1 oz. av. 293 gr.
Lactic Acid	16 mils	246 min.
Acacia, in fine powder	125 Gm.	4 oz. av. 76 gr.
Syrup of Tolu	100 mils	3 fl. oz. 96 min.
Flavoring (see above),		
Water, each, a sufficient quantity,		
To make	1000 mils	2 pints

Triturate the acacia with the cod liver oil in a dry mortar, until uniformly mixed, then add at once 250 mils [old form 8 fl. oz.] of water and triturate the mixture rapidly until complete emulsification results. Dissolve the calcium lactophosphate in 65 mils [old form 2 fl. oz. 38 minims] of water with the aid of the lactic acid, and incorporate this solution with the emulsion just prepared, adding the flavoring, the syrup of tolu and sufficient water to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly.

Average dose.—4 fluidrachms (15 mils).

EMULSUM OLEI MORRHUÆ CUM CALCII PHOSPHATE. N. F.

Emulsion of Cod Liver Oil with Calcium Phosphate

[Emul. Ol. Morrh. c. Calc. Phos. EMULSION OF COD LIVER OIL WITH PHOSPHATE OF LIME]

	Metric	Old form
Cod Liver Oil	500 mils	1 pint
Acacia, in fine powder	125 Gm.	4 oz. av. 76 gr.
Precipitated Calcium Phosphate	35 Gm.	1 oz. av. 74 gr.
Syrup of Tolu	100 mils	3 fl. oz. 96 min.
Flavoring (see page 357),		
Water, each, a sufficient quantity,		
To make	1000 mils	2 pints

Triturate the acacia with the cod liver oil in a dry mortar, until uniformly mixed, then add at once 250 mils [old form 8 fl. oz.] of water and triturate lightly and rapidly until the oil is completely emulsified. Then incorporate the flavoring, and the syrup of tolu and precipitated calcium phosphate, previously mixed, and lastly sufficient water to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly.

Average dose.—4 fluidrachms (15 mils).

EMULSUM OLEI MORRHUÆ CUM HYPOPHOSPHITIBUS. N. F.

Emulsion of Cod Liver Oil with Hypophosphites

(U. S. P. VIII)

[Emul. Ol. Morrh. c. Hypophos.]

	Metric	Old form
Cod Liver Oil	500 mils	1 pint
Acacia, in fine powder	125 Gm.	4 oz. av. 76 gr.
Calcium Hypophosphite	10 Gm.	146 gr.
Potassium Hypophosphite	5 Gm.	73 gr.
Sodium Hypophosphite	5 Gm.	73 gr.
Syrup	100 mils	3 fl. oz. 96 min.
Flavoring (see page 357),		
Water, each, a sufficient quantity,		
To make	1000 mils	2 pints

Triturate the acacia with the cod liver oil in a dry mortar until uniformly mixed, then add at once 250 mils [old form 8 fl. oz.] of water and triturate lightly and rapidly until the oil is completely emulsified, add the flavoring and incorporate thoroughly. Dissolve the hypophosphites in 100 mils [old form 3 fl. oz. 96 minims] of water, mix the solution with the syrup, and add this liquid gradually to the emulsion with continued trituration. Finally add sufficient water to make the product measure 1000 mils [old form 2 pints] and mix thoroughly.

Average dose.—2 fluidrachms (8 mils).

EMULSUM OLEI MORRHUÆ CUM MALTO. N. F. Emulsion of Cod Liver Oil with Malt

[Emul. Ol. Morrh. c. Malt.]

	Metric	Old form
Cod Liver Oil	300 mils	9 fl. oz. 288 min.
Tragacanth, in fine powder	3 Gm.	44 gr.
Water	150 mils	4 fl. oz. 384 min.
Extract of Malt, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the oil and tragacanth thoroughly in a bottle, add the water and shake the mixture until a homogeneous suspension is formed, finally add the extract of malt in portions, shaking the mixture thoroughly after each addition, until the finished product measures 1000 mils [old form 2 pints].

Average dose.—4 fluidrachms (15 mils).

EMULSUM OLEI MORRHUÆ CUM PRUNO VIRGINIANA. N. F.
Emulsion of Cod Liver Oil with Wild Cherry
[Emul. Ol. Morrh. c. Prun. Virg.]

	Metric	Old form
Cod Liver Oil	**500 mils**	1 pint
Acacia, in fine powder	**125 Gm.**	4 oz. av. 76 gr.
Fluidextract of Wild Cherry	**65 mils**	2 fl. oz. 38 min.
Syrup of Tolu	**100 mils**	3 fl. oz. 96 min.
Flavoring (see page 357),		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Triturate the acacia with the cod liver oil in a dry mortar, until uniformly mixed, then add at once 250 mils [old form 8 fl. oz.] of water and triturate lightly and rapidly until the oil is completely emulsified. Then gradually incorporate the fluidextract and syrup, previously mixed with a portion of the remaining water, and finally add sufficient water to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly.

Average dose.—4 fluidrachms (15 mils).

EMULSUM OLEI MORRHUÆ CUM VITELLO. N. F. Emulsion of Cod Liver Oil with Egg
[Emul. Ol. Morrh. c. Vitel.]

	Metric	Old form
Cod Liver Oil	**500 mils**	1 pint
Glycerite of Yolk of Egg	**175 mils**	5 fl. oz. 288 min.
Syrup of Tolu	**100 mils**	3 fl. oz. 96 min.
Flavoring (see page 357),		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Triturate the glycerite of yolk of egg in a mortar with the oil, added in small portions at a time, and thoroughly emulsify each portion before adding the next. Then, continuing the trituration, gradually add the syrup of tolu, and the flavoring. Finally add sufficient water to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly.

Average dose.—4 fluidrachms (15 mils).

EMULSUM OLEI RICINI. N. F. Emulsion of Castor Oil
[Emul. Ol. Ricin.]

	Metric	Old form
Castor Oil	**35.0 mils**	2 fl. oz. 384 min.
Acacia, in fine powder	**9.0 Gm.**	329 gr.
Tincture of Vanilla	**2.5 mils**	96 min.
Syrup	**20.0 mils**	1 fl. oz. 288 min.
Water, a sufficient quantity,		
To make	**100 mils**	8 fl. oz.

Triturate the acacia with the castor oil in a dry mortar, until uniformly mixed, then add 18 mils [old form 1 fl. oz. 211 minims] of water and triturate lightly and rapidly until the oil is completely emulsified. Gradually incorporate the syrup and tincture, and finally add sufficient water to make the product measure 100 mils [old form 8 fl. oz]. Mix thoroughly.

Average dose.—1½ fluidounces (45 mils).

EMULSUM PETROLATI. N. F. Emulsion of Petrolatum

[Emul. Petrolat. EMULSUM PETROLEI, N. F. III]

	Metric	Old form
Petrolatum	**225 Gm.**	7 oz. av. 223 gr.
Expressed Oil of Almond	**225 mils**	7 fl. oz. 96 min.
Acacia, in fine powder	**125 Gm.**	4 oz. av. 76 gr.
Syrup	**100 mils**	3 fl. oz. 96 min.
Tincture of Lemon Peel	**15 mils**	230 min.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Triturate the melted petrolatum with the expressed oil of almond in a warm dry mortar, add the acacia and triturate until it is uniformly mixed. Then add 250 mils [old form 8 fl. oz.] of warm water and triturate rapidly until the mixture is completely emulsified. Now add the syrup and the tincture, previously mixed, and sufficient water to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly.

Average dose.—4 fluidrachms (15 mils).

Misturæ *Mixtures*

Mixtures, in a properly restricted sense, are aqueous liquid preparations intended for internal use, which contain suspended insoluble substances. The main object in introducing this class into the Pharmacopœia was to secure uniformity in the formulas of certain well-known and largely used preparations. They are not permanent, as a rule, and it is not wise to keep them on hand for any considerable length of time. They belong properly under the head of Extemporaneous Preparations. (See Mixtures, Part V.) There are *two* mixtures official in the U. S. P. IX and *twenty* in the N. F. IV.

Mixtures of the U. S. P.

Title	Ingredients	Method of Preparation
Mistura Cretæ	20 Gm. Compound Chalk Powder; 40 mils Cinnamon Water; Water, enough to make 100 mils	Rub the Compound Chalk Powder to a uniform mixture with the Cinnamon Water and 20 mils of Water, then add enough Water to make 100 mils
Glycyrrhizæ Composita	30 Gm. Pure Extract of Glycyrrhiza; 50 mils Syrup; 30 Gm. Acacia; 120 mils Camphorated Tincture of Opium; 0.24 Gm. Antimony and Potassium Tartrate; 30 mils Spirit of Nitrous Ether; Water, enough to make 1000 mils	Dissolve the Extract and Acacia in 500 mils of warm Water, cool, add the Antimony and Potassium Tartrate, dissolved in 12 mils of hot Water, then the other ingredients and enough Water to make 1000 mils

Mixtures of the N. F.

Title	Ingredients	Method of Preparation
Mistura Adstringens	100 mils Solution of Lead Subacetate; 65 Gm. Copper Sulphate; 65 Gm. Zinc Sulphate; 850 mils Diluted Acetic Acid	Dissolve the Copper and Zinc Sulphates in the Acid, add the Solution of Lead Subacetate and mix thoroughly before dispensing
Ammonii Chloridi	25 Gm. Ammonium Chloride; 25 Gm. Pure Extract of Glycyrrhiza; Water, enough to make 1000 mils	Dissolve the solid ingredients in enough Water to make 1000 mils
Camphoræ Acida	17.5 mils Nitric Acid; 12 mils Tincture of Opium; Camphor Water, enough to make 1000 mils	Mix the Nitric Acid and Tincture with enough Camphor Water to make 1000 mils
Camphoræ Aromatica	250 mils Compound Tincture of Lavender; 35 Gm. Sugar; Camphor Water, enough to make 1000 mils	Mix the Tincture with 500 mils of Camphor Water; dissolve the Sugar and add enough Camphor Water to make 1000 mils
Carminativa	65 Gm. Magnesium Carbonate; 3 Gm. Potassium Carbonate; 25 mils Tincture of Opium; 0.5 mil each, Oils of Caraway, Fennel, and Peppermint; 160 mils Syrup; Water, enough to make 1000 mils	Triturate the Oils with the Magnesium Carbonate and 750 mils of Water, add the other ingredients and enough Water to make 1000 mils
Chloralis et Potassii Bromidi Composita	200 Gm. Hydrated Chloral; 200 Gm. Potassium Bromide; 2 Gm. Extract of Cannabis; 2 Gm. Extract of Hyoscyamus; 20 Gm. Pumice; Water, enough to make 1000 mils	Mix the Extracts and Pumice in a mortar. Dissolve the Hydrated Chloral and Potassium Bromide in 625 mils of hot Water and add the hot solution to the Extract mixture. Shake it occasionally during 24 hours, filter, and add enough Water to make 1000 mils
Chloroformi et Morphinæ Composita	125 mils Chloroform; 32.5 mils Ether; 185 mils Tincture of Cannabis; 25 mils Tincture of Capsicum; 2.5 Gm. Morphine Sulphate; 2 mils Oil of Peppermint; 125 mils Glycerin; 65 mils Water; Alcohol, enough to make 1000 mils	Dissolve the Oil in 500 mils of Alcohol, add the Chloroform, Ether, and Tinctures and mix well. Then add the Morphine Sulphate, dissolved in the Water and Glycerin, and enough Water to make 1000 mils
Copaibæ	125 mils Copaiba; 125 mils Spirit of Nitrous Ether; 125 mils Compound Tincture of Lavender; 32 mils Solution of Potassium Hydroxide; 300 mils Syrup; Mucilage of Acacia, enough to make 1000 mils	Mix the Copaiba with the Potassium Hydroxide Solution and Spirit of Nitrous Ether, add the Tincture and Syrup and enough Mucilage of Acacia to make 1000 mils
Copaibæ et Opii	250 mils Copaiba; 250 mils Spirit of Nitrous Ether; 65 mils Compound Tincture of Lavender; 32 mils Tincture of Opium; 125 mils Mucilage of Acacia; Water, enough to make 1000 mils	Mix the Copaiba and Mucilage of Acacia, in a mortar, add 250 mils of Water and triturate until emulsified. Then slowly add the Tinctures and the Spirit and enough Water to make 1000 mils
Ferri Composita	6 Gm. Ferrous Sulphate; 18 Gm. Myrrh; 18 Gm. Sugar; 8 Gm. Potassium Carbonate; 60 mils Spirit of Lavender; Rose Water, enough to make 1000 mils	Rub the Myrrh, Sugar and Potassium Carbonate with 700 mils of Rose Water, added very slowly at first, until uniform. Then add the Spirit and the Ferrous Sulphate, dissolved in 50 mils of Rose Water, and enough of the latter to make 1000 mils
Guaiaci	125 mils Tincture of Guaiac; 250 mils Clarified Honey; Cinnamon Water; enough to make 1000 mils	Add the Tincture slowly to the Honey with brisk trituration and then add enough Cinnamon Water to make 1000 mils
Magnesiæ, Asafœtidæ et Opii	50 Gm. Magnesium Carbonate; 75 mils Tincture of Asafetida; 10 mils Tincture of Opium; 100 Gm. Sugar; Water, enough to make 1000 mils	Rub the Magnesium Carbonate and Sugar, in a mortar, with the Tinctures and add enough Water to make 1000 mils
Olei Picis	35 mils Rectified Oil of Tar; 65 Gm. Pure Extract of Glycyrrhiza; 250 Gm. Sugar; 10 mils Chloroform; 3 mils Oil of Peppermint; 160 mils Alcohol; Water, enough to make 1000 mils	Add the Extract and Sugar to 500 mils of Water and heat until dissolved, then cool, add the Oil of Tar and Chloroform, the Oil of Peppermint, dissolved in the Alcohol, and enough Water to make 1000 mils

Mixtures of the N. F.—*Continued*

Title	Ingredients	Method of Preparation
Mistura Oleo-Balsamica	4 mils each of Oil of Lavender, Eugenol, Oil of Cinnamon, Oil of Thyme, Oil of Lemon, and Oil of Myristica; 16 mils Balsam of Peru; Alcohol, enough to make 1000 mils	Dissolve the Oils, Eugenol, and Balsam of Peru in enough Alcohol to make 1000 mils
Opii et Chloroformi Composita	200 mils Tincture of Opium; 200 mils Spirit of Camphor; 100 mils Tincture of Capsicum; 80 mils Chloroform; Alcohol, enough to make 1000 mils	Mix them
Opii et Rhei Composita	100 mils Tincture of Capsicum; 100 mils Tincture of Rhubarb; 200 mils Tincture of Opium; 200 mils Spirit of Camphor; 200 mils Spirit of Peppermint; Alcohol, enough to make 1000 mils	Mix them
Opii et Sassafras	35 mils Tincture of Opium; 1 mil Oil of Sassafras; 50 mils Alcohol; 8 Gm. Potassium Carbonate; 325 mils Syrup; Water, enough to make 1000 mils	Mix the Tincture with the Alcohol and Oil. Dissolve the Potassium Carbonate in 500 mils of Water, add the Syrup, the alcoholic solution first prepared, and enough Water to make 1000 mils and filter
Pectoralis, Stokes	17.5 Gm. Ammonium Carbonate; 35 mils Fluidextract of Senega; 35 mils Fluidextract of Squill; 175 mils Camphorated Tincture of Opium; 85 mils Water; Syrup of Tolu, enough to make 1000 mils	Mix the Fluidextracts and Tincture with the Ammonium Carbonate, previously dissolved in the Water, then add enough Syrup of Tolu to make 1000 mils
Rhei Alkalina	16 mils Fluidextract of Rhubarb; 8 mils Fluidextract of Hydrastis; 16 Gm. Potassium Carbonate; 64 mils Tincture of Cinnamon; 8 mils Spirit of Peppermint; 250 mils Syrup; Diluted Alcohol, enough to make 1000 mils	Dissolve the Potassium Carbonate in the Syrup, add the solution to the Fluidextracts, Tincture and Spirit, previously mixed with 500 mils Diluted Alcohol, mix and add enough Diluted Alcohol to make 1000 mils
Rhei Composita	15 mils Fluidextract of Rhubarb; 3 mils Fluidextract of Ipecac; 35 Gm. Sodium Bicarbonate; 350 mils Glycerin; 35 mils Spirit of Peppermint; Water, enough to make 1000 mils	Dissolve the Sodium Bicarbonate in 400 mils of Water, add the Fluidextracts, Glycerin, Spirit of Peppermint, and enough Water to make 1000 mils and filter

Unofficial Mixtures[1]

Title	Ingredients	Method of Preparation
Mistura Guaiaci. Br.	25 Gm. Guaiacum Resin; 25 Gm. Sugar; 5 Gm. Tragacanth; Cinnamon Water, enough to make 1000 mils	Triturate the Guaiacum Resin with the Sugar and the Tragacanth, and gradually add the Cinnamon Water
Sennæ Compositа. Br.	250 Gm. Magnesium Sulphate; 50 mils Liquid Extract of Liquorice; 100 mils Compound Tincture of Cardamoms; 50 mils Aromatic Spirit of Ammonia; Infusion of Senna, enough to make 1000 mils	Dissolve the Magnesium Sulphate in 500 mils Infusion of Senna, add the other ingredients and enough Infusion of Senna to make 1000 mils

[1] In the British Pharmacopœia (1914) preparations are included in the class Misturæ which should more properly be placed under the head Emulsa.

MISTURA CRETÆ. U. S. Chalk Mixture

[Mist. Cret.]

	Metric	Old form
*Compound Chalk Powder	20 Gm.	365 gr.
Cinnamon Water	40 mils	1½ fl. oz.
Water, a sufficient quantity,		
To make	100 mils	4 fl. oz.

Gradually add the cinnamon water and about 20 mils [old form 6 fl. dr.] of water to the compound chalk powder in a mortar, triturating until the mixture is uniform; transfer this to a graduated vessel, rinse the mortar with enough water to make the product measure 100 mils [old form 4 fl. oz.] and mix the whole thoroughly. This preparation must not be dispensed unless it has been recently prepared.

Average dose.—4 fluidrachms (15 mils).

MISTURA GLYCYRRHIZÆ COMPOSITA. U. S. Compound Mixture of Glycyrrhiza

[Mist. Glycyrrh. Co. BROWN MIXTURE]

	Metric	Old form
*Pure Extract of Glycyrrhiza	30.000 Gm.	1 oz. av.
Syrup	50.000 mils	1 fl. oz. 288 min.
Acacia, granulated	30.000 Gm.	1 oz. av.
Antimony and Potassium Tartrate	0.240 Gm.	3½ gr.
Camphorated Tincture of Opium	120.000 mils	3 fl. oz. 403 min.
Spirit of Nitrous Ether	30.000 mils	461 min.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Rub the pure extract of glycyrrhiza and acacia in a mortar with 500 mils [old form 1 pint] of warm water until they are dissolved. Allow the solution to cool, transfer it to a graduated vessel, add the antimony and potassium tartrate, dissolved in 12 mils [old form 184 minims] of hot water, then the other ingredients and rinse the mortar with enough water to make the product measure 1000 mils [old form 2 pints]. Mix the whole thoroughly.

Average dose.—2½ fluidrachms (10 mils).

MISTURA ADSTRINGENS. N. F. Astringent Mixture

[Mist. Adstring. MISTURA ADSTRINGENS ET ESCHAROTICA, N. F. III VILLATE'S MIXTURE]

	Metric	Old form
Solution of Lead Subacetate	100 mils	3 fl. oz. 183 min.
Copper Sulphate	65 Gm.	2 oz. av. 128 gr.
Zinc Sulphate	65 Gm.	2 oz. av. 128 gr.
Diluted Acetic Acid	850 mils	28 fl. oz. 356 min.

Dissolve the copper sulphate and zinc sulphate in the diluted acetic acid, add the solution of lead subacetate, and agitate thoroughly.

Shake this preparation well before dispensing it, so that the precipitate will be uniformly distributed.

MISTURA AMMONII CHLORIDI. N. F. Mixture of Ammonium Chloride

[Mist. Ammon. Chlor. MISTURA SOLVENS SIMPLEX]

	Metric	Old form
Ammonium Chloride	25 Gm.	365 gr.
Pure Extract of Glycyrrhiza	25 Gm.	365 gr.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the ammonium chloride and the extract in sufficient water to make the product measure 1000 mils [old form 2 pints].

Average dose.—2 fluidrachms (8 mils).

MISTURA CAMPHORÆ ACIDA. N. F. Acid Camphor Mixture

[Mist. Camph. Acid. MISTURA ANTIDYSENTERICA HOPE'S MIXTURE]

	Metric	Old form
Nitric Acid	17.5 mils	269 min.
Tincture of Opium	12.0 mils	184 min.
Camphor Water, a sufficient quantity,		
To make	1000 mils	2 pints

Add the nitric acid, and then the tincture of opium, to sufficient camphor water to make the product measure 1000 mils [old form 2 pints].

Average dose.—2 fluidrachms (8 mils).

MISTURA CAMPHORÆ AROMATICA. N. F. Aromatic Camphor Mixture

[Mist. Camph. Arom. PARRISH'S CAMPHOR MIXTURE]

	Metric	Old form
Compound Tincture of Lavender	250 mils	8 fl. oz.
Sugar	35 Gm.	1 oz. av. 74 gr.
Camphor Water, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the compound tincture of lavender with 500 mils [old form 1 pint] of camphor water, dissolve the sugar in the mixture, and add sufficient camphor water to make the product measure 1000 mils [old form 2 pints].

Average dose.—2 fluidrachms (8 mils).

MISTURA CARMINATIVA. N. F. Carminative Mixture

[Mist. Carminat. DALBY'S CARMINATIVE]

	Metric	Old form
Magnesium Carbonate	65.0 Gm.	2 oz. av. 74 gr.
Potassium Carbonate	3.0 Gm.	44 gr.
Tincture of Opium	25.0 mils	384 min.
Oil of Caraway	0.5 mil	8 min.
Oil of Fennel	0.5 mil	8 min.
Oil of Peppermint	0.5 mil	8 min.
Syrup	160.0 mils	5 fl. oz. 58 min.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Triturate the oils with the magnesium carbonate and 750 mils [old form 24 fl. oz.] of water, gradually added. Then add the other ingredients, and, lastly, sufficient water to make the product measure 1000 mils [old form 2 pints].

Average dose.—Infants, 8 minims (0.5 mil).

MISTURA CHLORALIS ET POTASSII BROMIDI COMPOSITA. N. F.

Compound Mixture of Chloral and Potassium Bromide

[Mist. Chloral. et Pot. Brom. Co. CHLORAL AND BROMIDE COMPOUND]

	Metric	Old form
Hydrated Chloral	**200 Gm.**	6 oz. av. 296 gr.
Potassium Bromide	**200 Gm.**	6 oz. av. 296 gr.
Extract of Cannabis	**2 Gm.**	29 gr.
Extract of Hyoscyamus	**2 Gm.**	29 gr.
Pumice, in fine powder and well washed	**20 Gm.**	292 gr.
Water, a sufficient quantity,		
To make	**1000 mils**	**2 pints**

Triturate the extracts in a mortar with the pumice, gradually added, until they are thoroughly mixed. Dissolve the hydrated chloral and potassium bromide in 625 mils [old form 20 fl. oz.] of water, previously heated to about 90° C. (194° F.) and gradually add the hot solution to the extracts and pumice with constant trituration. Set the mixture aside during twenty-four hours, shaking it occasionally, then filter and add sufficient water, through the filter, to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

MISTURA CHLOROFORMI ET MORPHINÆ COMPOSITA. N. F.

Compound Mixture of Chloroform and Morphine

[Mist. Chlorof. et Morph. Co. MISTURA CHLOROFORMI ET CANNABIS INDICÆ COMPOSITA, N. F. III CHLOROFORM ANODYNE]

	Metric	Old form
Chloroform	**125.0 mils**	4 fl. oz.
Ether	**32.5 mils**	1 fl. oz. 20 min.
Tincture of Cannabis	**185.0 mils**	5 fl. oz. 442 min.
Tincture of Capsicum	**25.0 mils**	384 min.
Morphine Sulphate	**2.5 Gm.**	36 gr.
Oil of Peppermint	**2.0 mils**	31 min.
Glycerin	**125.0 mils**	4 fl. oz.
Water	**65.0 mils**	2 fl. oz. 38 min.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	**2 pints**

Dissolve the oil of peppermint in 500 mils [old form 1 pint] of alcohol, add the chloroform, ether, and the tinctures and mix well. Then add the morphine sulphate, previously dissolved in the water and glycerin, to this solution, and finally sufficient alcohol to make the product measure 1000 mils [old form 2 pints].

Average dose.—30 minims (2 mils).

MISTURA COPAIBÆ. N. F. Copaiba Mixture

[Mist. Copaib. LAFAYETTE MIXTURE]

	Metric	Old form
Copaiba	**125 mils**	4 fl. oz.
Spirit of Nitrous Ether	**125 mils**	4 fl. oz.
Compound Tincture of Lavender	**125 mils**	4 fl. oz.
Solution of Potassium Hydroxide	**32 mils**	1 fl. oz. 12 min.
Syrup	**300 mils**	9 fl. oz. 288 min.
Mucilage of Acacia, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the copaiba thoroughly with the solution of potassium hydroxide and the spirit of nitrous ether, then add the compound tincture of lavender and, lastly, the syrup and mucilage of acacia. Mix the whole thoroughly by shaking. Shake this mixture well before it is dispensed.

Average dose.—2 fluidrachms (8 mils).

MISTURA COPAIBÆ ET OPII. N. F. Mixture of Copaiba and Opium

[Mist. Copaib. et Opii CHAPMAN'S MIXTURE]

	Metric	Old form
Copaiba	**250 mils**	8 fl. oz.
Spirit of Nitrous Ether	**250 mils**	8 fl. oz.
Compound Tincture of Lavender	**65 mils**	2 fl. oz. 38 min.
Tincture of Opium	**32 mils**	1 fl. oz. 12 min.
Mucilage of Acacia	**125 mils**	4 fl. oz.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the copaiba and mucilage of acacia thoroughly by trituration and gradually add 250 mils [old form 8 fl. oz.] of water, continuing the trituration. When a smooth emulsion is obtained, gradually add, in the same manner, the tincture of opium, compound tincture of lavender, and then the spirit of nitrous ether. Finally add sufficient water to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

MISTURA FERRI COMPOSITA. N. F. Compound Iron Mixture

(U. S. P. VIII)

[Mist. Ferr. Co. GRIFFITH'S MIXTURE]

	Metric	Old form
Ferrous Sulphate, in clear crystals	**6 Gm.**	88 gr.
Myrrh, in small pieces	**18 Gm.**	263 gr.
Sugar	**18 Gm.**	263 gr.
Potassium Carbonate	**8 Gm.**	117 gr.
Spirit of Lavender	**60 mils**	1 fl. oz. 442 min.
Rose Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Rub the myrrh, sugar and potassium carbonate in a mortar, with 700 mils [old form 22 fl. oz. 192 minims] of rose water, at first very gradually added, so that a uniform mixture may result. Transfer this to a graduated vessel, add the spirit of lavender, then the ferrous sulphate, previously dissolved in about 50 mils [old form 1 fl. oz. 288 minims] of rose water, and, lastly, enough rose water to make the product measure 1000 mils [old form 2 pints]. Mix the whole thoroughly.

This mixture should not be dispensed unless it has been recently prepared.

Average dose.—4 fluidrachms (15 mils).

MISTURA GUAIACI. N. F. Mixture of Guaiac

[Mist. Guaiac.]

	Metric	Old form
Tincture of Guaiac	125 mils	4 fl. oz.
Clarified Honey	250 mils	8 fl. oz.
Cinnamon Water, a sufficient quantity,		
To make	1000 mils	2 pints

Place the honey in a mortar and gradually add the tincture of guaiac with brisk trituration. Then add sufficient cinnamon water, in portions, to make the product measure 1000 mils [old form 2 pints], mixing each portion thoroughly by trituration before adding the next.

Shake this mixture well before it is dispensed.

Average dose.—4 fluidrachms (15 mils).

MISTURA MAGNESIÆ, ASAFŒTIDÆ ET OPII. N. F. Mixture of Magnesia, Asafetida and Opium

[Mist. Mag., Asafœt. et Opii MISTURA MAGNESIÆ ET ASAFŒTIDÆ, N. F. III DEWEES' CARMINATIVE]

	Metric	Old form
Magnesium Carbonate	50 Gm.	1 oz. av. 293 gr.
Tincture of Asafetida	75 mils	2 fl. oz. 192 min.
Tincture of Opium	10 mils	154 min.
Sugar	100 Gm.	3 oz. av. 148 gr.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Rub the magnesium carbonate and sugar in a mortar, with the tincture of asafetida and the tincture of opium. Then gradually add sufficient water to make the product measure 1000 mils [old form 2 pints].

Average dose.—2 fluidrachms (8 mils).

MISTURA OLEI PICIS. N. F. Mixture of Oil of Tar

[Mist. Ol. Pic. MISTURA PICIS LIQUIDÆ TAR MIXTURE]

	Metric	Old form
Rectified Oil of Tar	35 mils	1 fl. oz. 58 min.
Pure Extract of Glycyrrhiza	65 Gm.	2 oz. av. 74 gr.
Sugar	250 Gm.	8 oz. av. 151 gr.
Chloroform	10 mils	2½ fl. dr.
Oil of Peppermint	3 mils	46 min.
Alcohol	160 mils	5 fl. oz. 58 min.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Add the pure extract of glycyrrhiza and sugar to 500 mils [old form 1 pint] of water, contained in a covered vessel, and heat the mixture until the extract and sugar are dissolved. Cool and add the rectified oil of tar, the chloroform and the oil of peppermint, previously dissolved in the alcohol, and, lastly, sufficient water to make the product measure 1000 mils [old form 2 pints].

Shake this mixture before it is dispensed.

Average dose.—2 fluidrachms (8 mils).

MISTURA OLEO-BALSAMICA. N. F. Oleo-Balsamic Mixture

[Mist. Ol.-Balsam.]

	Metric	Old form
Oil of Lavender	4 mils	1 fl. dr.
Eugenol	4 mils	1 fl. dr.
Oil of Cinnamon	4 mils	1 fl. dr.
Oil of Thyme	4 mils	1 fl. dr.
Oil of Lemon	4 mils	1 fl. dr.
Oil of Myristica	4 mils	1 fl. dr.
Balsam of Peru	16 mils	4 fl. dr.
Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the oils, eugenol and balsam of Peru in 900 mils [old form 28 fl. oz. 384 minims] of alcohol, filter, and add sufficient alcohol, through the filter, to make the product measure 1000 mils [old form 2 pints].

MISTURA OPII ET CHLOROFORMI COMPOSITA. N. F. Compound Mixture of Opium and Chloroform

[Mist. Opii et Chlorof. Co. SQUIBB'S DIARRHŒA MIXTURE]

	Metric	Old form
Tincture of Opium	200 mils	6 fl. oz. 192 min.
Spirit of Camphor	200 mils	6 fl. oz. 192 min.
Tincture of Capsicum	100 mils	3 fl. oz. 96 min.
Chloroform	80 mils	2 fl. oz. 269 min.
Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Mix them.

Average dose.—30 minims (2 mils).

MISTURA OPII ET RHEI COMPOSITA. N. F. Compound Mixture of Opium and Rhubarb

[Mist. Opii et Rhei Co. SUN CHOLERA MIXTURE]

	Metric	Old form
Tincture of Capsicum	100 mils	3 fl. oz. 96 min.
Tincture of Rhubarb	100 mils	3 fl. oz. 96 min.
Tincture of Opium	200 mils	6 fl. oz. 192 min.
Spirit of Camphor	200 mils	6 fl. oz. 192 min.
Spirit of Peppermint	200 mils	6 fl. oz. 192 min.
Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Mix them.

Average dose.—30 minims (2 mils).

MISTURA OPII ET SASSAFRAS. N. F. Mixture of Opium and Sassafras

[Mist. Opii et Sassaf. MISTURA SASSAFRAS ET OPII, N. F. III
MISTURA OPII ALKALINA GODFREY'S CORDIAL]

	Metric	Old form
Tincture of Opium	35 mils	1 fl. oz. 58 min.
Oil of Sassafras	1 mil	15 min.
Alcohol	50 mils	1 fl. oz. 288 min.
Potassium Carbonate	8 Gm.	117 gr.
Syrup	325 mils	10 fl. oz. 192 min.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the tincture of opium with the alcohol containing the oil of sassafras. Dissolve the potassium carbonate in 500 mils [old form 1 pint] of water, mix this with the syrup, then add the mixture first prepared, and, lastly, sufficient water to make the product measure 1000 mils [old form 2 pints]. Allow the mixture to stand during twenty-four hours and then filter.

Average dose.—Infants, 5 minims (0.3 mil).

MISTURA PECTORALIS, STOKES. N. F. Stokes' Expectorant

[Mist. Pect. Stokes]

	Metric	Old form
Ammonium Carbonate	17.5 Gm.	255 gr.
Fluidextract of Senega	35.0 mils	1 fl. oz. 58 min.
Fluidextract of Squill	35.0 mils	1 fl. oz. 58 min.
Camphorated Tincture of Opium	175.0 mils	5 fl. oz. 288 min.
Water	85.0 mils	2 fl. oz. 346 min.
Syrup of Tolu, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the fluidextract of squill with the fluidextract of senega, the camphorated tincture of opium, and the ammonium carbonate, previously dissolved in the water; then add sufficient syrup of tolu to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

MISTURA RHEI ALKALINA. N. F. Alkaline Mixture of Rhubarb

[Mist. Rhei Alk. SYRUPUS RHEI ET POTASSII COMPOSITUS, N. F. III
NEUTRALIZING CORDIAL]

	Metric	Old form
Fluidextract of Rhubarb	16 mils	246 min.
Fluidextract of Hydrastis	8 mils	2 fl. dr.
Potassium Carbonate	16 Gm.	234 gr.
Tincture of Cinnamon	64 mils	2 fl. oz. 23 min.
Spirit of Peppermint	8 mils	2 fl. dr.
Syrup	250 mils	8 fl. oz.
Diluted Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the potassium carbonate in the syrup, and add the solution to the fluidextracts, tincture and spirit, previously mixed with 500 mils [old form 1 pint] of diluted alcohol. Mix well, add sufficient diluted alcohol to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

MISTURA RHEI COMPOSITA. N. F. Compound Mixture of Rhubarb

(U. S. P. VIII)

[Mist. Rhei Co. MISTURA RHEI ET SODÆ, U. S. P. VIII MIXTURE OF RHUBARB AND SODA]

	Metric	Old form
Fluidextract of Rhubarb	15 mils	230 min.
Fluidextract of Ipecac	3 mils	46 min.
Sodium Bicarbonate	35 Gm.	1 oz. av. 74 gr.
Glycerin	350 mils	11 fl. oz. 96 min.
Spirit of Peppermint	35 mils	1 fl. oz. 58 min.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the sodium bicarbonate in about 400 mils [old form 12 fl. oz. 384 minims] of water. Add the fluidextracts, the glycerin, and the spirit of peppermint, and, lastly, sufficient water to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

Magmæ *Magmas*

This title has been introduced into the U. S. P. IX for the first time as a Latin title and is applied to a class of preparations closely related to the mixtures. The suspended, insoluble constituents are of inorganic chemical origin and are freshly precipitated in a fine state of subdivision. There are *two* preparations in the U. S. P. and *one* in the N. F. A brief outline will be given in the table below but the formulas and tests will be found in Part III.

Magmas of the U. S. P. IX and N. F. IV

Title	Ingredients	Method of Preparation
Magma Bismuthi, U. S. P.	80 Gm. Bismuth Subnitrate; 120 mils Nitric Acid; 10 Gm. Ammonium Carbonate, Ammonia Water and Distilled Water, each, enough to make 1000 mils	Dissolve the Bismuth Subnitrate, with the aid of heat, in 60 mils of Nitric Acid, diluted with an equal volume of Water. Pour this solution with stirring into 5000 mils of Water containing 60 mils of Nitric Acid. Dilute 480 mils of Ammonia Water with 4000 mils of Water, dissolve the Ammonium Carbonate in the liquid and immediately add the Bismuth solution with active stirring. Wash the precipitate with Water until the washings no longer react with phenolphthalein and adjust the volume to measure 1000 mils
Magnesiæ U. S. P.	125 Gm. Magnesium Carbonate; 80 Gm. Sodium Hydroxide; Distilled Water, enough to make 1000 mils	Mix the Magnesium Carbonate with about 500 mils of Water and add the Sodium Hydroxide, dissolved in 400 mils of Water, with constant stirring, and agitate frequently during 15 minutes. Wash the precipitate until practically free from alkali, as determined by a test, and adjust the volume to measure 1000 mils
Ferri Hydroxidi N. F.	100 mils Solution of Ferric Sulphate; 138 mils Ammonia Water; Water, enough to make 300 Gm.	Dilute the Solution of Ferric Sulphate with 1000 mils of cold water and add it to the Ammonia Water, which has been diluted with 500 mils of cold water, stirring constantly. Wash the precipitate until the washings show only a slight cloudiness with Barium Chloride T.S. and adjust the volume to weigh 300 Gm.

Gargarismæ *Gargles*

Only one representative of this class of preparations is found in the official books. It is as follows:

GARGARISMA GUAIACI COMPOSITUM. N. F. **Compound Gargle of Guaiac**

[Garg. Guaiac. Co.]

	Metric	Old form
Ammoniated Tincture of Guaiac	**100 mils**	3 fl. oz. 96 min.
Compound Tincture of Cinchona	**100 mils**	3 fl. oz. 96 min.
Clarified Honey	**200 mils**	6 fl. oz. 192 min.
Potassium Chlorate	**40 Gm.**	1 oz. av. 147 gr.
Oil of Peppermint	**2 mils**	31 min.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Place the clarified honey in a bottle graduated to 1000 mils [old form 2 pints] and gradually add the previously mixed oil of peppermint and the tinctures, shaking the bottle after each addition. Dissolve the potassium chlorate in 500 mils [old form 1 pint] of warm water, and add this solution to the honey mixture in divided portions, shaking continuously, and finally add sufficient water to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly.

Lotiones *Lotions*

Representatives of this class of preparations are official only in the N. F., *four* being recognized. They are largely aqueous, usually contain insoluble, suspended matter, and are intended for use as a wash or injection.

Lotions of the N. F. IV

Title	Ingredients	Method of Preparation
Lotio Ammoniacalis Camphorata	60 Gm. Sodium Chloride; 60 mils Ammonia Water; 10 mils Spirit of Camphor; Water, enough to make 1000 mils	Dissolve the Sodium Chloride in 900 mils of Water, add the Spirit, then the Ammonia Water and enough Water to make 1000 mils
Flava	3 Gm. Corrosive Mercuric Chloride; 35 mils Boiling Water; Solution of Calcium Hydroxide (Lime Water), enough to make 1000 mils	Dissolve the Mercuric Chloride in the Boiling Water and add the solution gradually, with constant stirring, to enough Lime Water to make 1000 mils
Nigra	8.75 Gm. Mild Mercurous Chloride; 15 mils Water; Lime Water, enough to make 1000 mils	Triturate the Calomel with the Water and gradually add enough Lime Water to make 1000 mils
Plumbi et Opii	17.5 Gm. Lead Acetate; 35 mils Tincture of Opium, and enough water to make 1000 mils	Dissolve the Lead Acetate in 650 mils of Water, add the Tincture and enough Water to make 1000 mils

LOTIO AMMONIACALIS CAMPHORATA. N. F. Ammoniated Camphor Wash

[Lot. Ammon. Camph. Aqua Sedativa, N. F. III Sedative Water Eau Sedative de Raspail]

	Metric	Old form
Sodium Chloride	60 Gm.	2 oz. av. 1 gr.
Ammonia Water	60 mils	1 fl. oz. 442 min.
Spirit of Camphor	10 mils	154 min.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the sodium chloride in about 900 mils [old form 28 fl. oz. 384 minims] of water, add the spirit of camphor, then the ammonia water, and finally sufficient water to make the product measure 1000 mils [old form 2 pints].

Keep it in well-stoppered bottles and shake the lotion before it is dispensed.

LOTIO FLAVA. N. F. Yellow Lotion

[Lot. Flav. Yellow Wash Aqua Phagedænica Flava]

	Metric	Old form
Corrosive Mercuric Chloride	3 Gm.	44 gr.
Boiling Water	35 mils	1 fl. oz. 58 min.
Solution of Calcium Hydroxide, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the corrosive mercuric chloride in the boiling water, and add the solution gradually, with constant agitation, to sufficient solution of calcium hydroxide to make the product measure 1000 mils [old form 2 pints].

Shake the lotion thoroughly before it is dispensed.

LOTIO NIGRA. N. F. Black Lotion

[Lot. Nigr. Black Wash Aqua Phagedænica Nigra]

	Metric	Old form
Mild Mercurous Chloride	8.75 Gm.	128 gr.
Water	15.00 mils	4 fl. dr.
Solution of Calcium Hydroxide, a sufficient quantity,		
To make	1000 mils	2 pints

Triturate the mild mercurous chloride with the water, and gradually add sufficient solution of calcium hydroxide, with trituration, to make the product measure 1000 mils [old form 2 pints].

Shake the lotion thoroughly before it is dispensed.

LOTIO PLUMBI ET OPII. N. F. Lotion of Lead and Opium

[Lot. Plumb. et Opii Lead and Opium Wash]

	Metric	Old form
Lead Acetate	17.5 Gm.	255 gr.
Tincture of Opium	35.0 mils	1 fl. oz. 58 min.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the lead acetate in about 650 mils [old form 20 fl. oz. 384 minims] of water, add the tincture of opium, and sufficient water to make the product measure 1000 mils [old form 2 pints].

Shake the lotion thoroughly before it is dispensed.

Glycerita *Glycerites*

Glycerites are mixtures of medicinal substances with glycerin. Glycerin is a valuable solvent, and one of the principal advantages of the glycerites is that they afford a rapid and simple method of making aqueous solutions of substances which are not otherwise easily soluble. The solutions of phenol, gallic acid, tannic acid, tar, etc., in glycerin are permanent preparations, and they could be made very concentrated if necessary; the ease with which they can be diluted with water or alcohol, without precipitation, renders such glycerites especially useful at the prescription counter. *Five* glycerites are official in the U. S. P. IX and *six* in the N. F. IV.

Glycerites of the U. S. P. IX

Title	Ingredients	Method of Preparation
Glyceritum Acidi Tannici	20 Gm. Tannic Acid; 80 Gm. Glycerin	Add the Tannic Acid to the hot Glycerin, agitate the mixture until the Acid is dissolved and strain
Amyli	10 Gm. Starch; 80 Gm. Glycerin; 10 mils Water	Mix the Starch with the Water, add the Glycerin, and heat below 144° C. (291.2° F.) until a translucent jelly is formed
Boroglycerini	310 Gm. Boric Acid; Glycerin, enough to make 1000 Gm.	Heat 460 Gm. of Glycerin on a sand bath, between 140° to 150° C. (284° to 302° F.), add the Boric Acid, and continue the heat, stirring frequently until the mixture weighs 500 Gm. Then add 500 Gm. of Glycerin and mix thoroughly
Hydrastis	From 1.12 Gm. to 1.37 Gm. of ether-soluble Alkaloids in each 100 mils of Glycerite. 1000 Gm. Hydrastis; Glycerin, Alcohol, and Water, enough to make 1000 mils	Exhaust the drug by percolation with Alcohol, distil the Alcohol from the percolate, pour the thick liquid into 450 mils of ice water and cool for 24 hours. Then filter, assay filtrate, add Water to make each 100 mils contain 2.5 Gm. of Alkaloids, and finally add an equal volume of Glycerin
Phenolis	20 mils Liquefied Phenol; 80 mils Glycerin	Mix them

Glycerites of the N. F. IV

Title	Ingredients	Method of Preparation
Glyceritum Bismuthi	Each 100 mils yields not less than 12.8 Gm. Bismuth Oxide. 160 Gm. Bismuth Subnitrate; 150 mils Nitric Acid; 238 Gm. Tartaric Acid; 334 Gm. Sodium Bicarbonate, Glycerin and Distilled Water, each, enough to make 1000 mils	A soluble Bismuth and Sodium Tartrate is formed through chemical reaction and the solution mixed with an equal volume of Glycerin. The final volume is adjusted by assay
Guaiaci	85 Gm. Guaiac; 65 mils Solution of Potassium Hydroxide; 600 mils Glycerin; Water, enough to make 1000 mils	Add the powdered Guaiac to the Potassium Hydroxide Solution and macerate during 24 hours. Then filter, add the Glycerin and enough Water to make 1000 mils
Pepsini	85 Gm. Pepsin; 10 mils Hydrochloric Acid; 15 Gm. Purified Talc; 500 mils Glycerin, Distilled Water, enough to make 1000 mils	Dissolve the Pepsin in 350 mils of Distilled Water and the Hydrochloric Acid, incorporate the Talc, filter, and add enough Distilled Water to make 1000 mils
Picis Liquidæ	63 Gm. Tar; 125 Gm. Magnesium Carbonate; 250 mils Glycerin; 125 mils Alcohol, Water, enough to make 1000 mils	Wash the Tar with cold water until the washings are only slightly acid. Then add the Alcohol to the Tar, incorporate the Magnesium Carbonate and Glycerin, add 625 mils of Water and filter. Finally add through the filter enough Alcohol, 1 volume, Water, 7 volumes, to make 1000 mils
Tragacanthæ	125 Gm. Tragacanth; 775 mils Glycerin; 185 mils Water	Mix the Tragacanth and Glycerin, add the Water and stir until a thick paste results
Vitelli	45 Gm. Egg Yolk; 55 Gm. Glycerin	Mix the Yolk of Egg and the Glycerin in a mortar and strain the product

Unofficial Glycerites

Title	Ingredients	Method of Preparation
Glycerinum Aluminis. Br.[1]	20 Gm. Purified Alum; 7.5 mils Distilled Water; Glycerin, enough to make 120 mils	Effect solution, warming slightly if necessary, set aside and pour off the clear liquid
Boracis. Br.	20 Gm. Borax; 120 mils Glycerin	Triturate together in a warmed mortar until the Borax is dissolved
Plumbi Subacetatis. Br.	500 mils Strong Solution of Lead Subacetate; 500 mils Glycerin; Distilled Water, enough to make the specific gravity 1.48	Evaporate the Strong Solution of Lead Subacetate to dryness on a water bath, add the Glycerin, warm gently until dissolved, cool, add enough Distilled Water to make the specific gravity 1.48 and filter if necessary
Glyceritum Ferri, Quininæ et Strychninæ Phosphatum, U. S. P. VIII (Dilute with *three* volumes of Syrup to make *Syrupus Ferri, Quininæ et Strychninæ Phosphatum*, U. S. P. VIII)	80 Gm. Soluble Ferric Phosphate; 104 Gm. Quinine; 0.8 Gm. Strychnine; 200 mils Phosphoric Acid; 500 mils Glycerin; Water, enough to make 1000 mils	Dissolve the Soluble Ferric Phosphate in 200 mils of hot Water, add the Phosphoric Acid, the Strychnine and Quinine and enough Water to make 500 mils. Stir until solution is effected and then add the Glycerin

GLYCERITUM ACIDI TANNICI. U. S. Glycerite of Tannic Acid

[Glycer. Acid. Tann. GLYCERITE OF TANNIN]

	Metric	Old form
***Tannic Acid**	**20 Gm.**	4 oz. av.
Glycerin	**80 Gm.**	16 oz. av.
To make	**100 Gm.**	20 oz. av.

Weigh the glycerin into a tared, wide-mouthed bottle with a capacity of about 125 mils [old form 2 pints]. Place the bottle and contents in a water bath, heat the water until it boils, and continue the heat for a few minutes; add the tannic acid to the hot glycerin in small, successive portions, agitate the mixture until the tannic acid is dissolved and strain the solution while warm through purified cotton.

Average dose.—30 minims (2 mils).

GLYCERITUM AMYLI. U. S. Glycerite of Starch

[Glycer. Amyl.]

	Metric	Old form
***Starch**	**10 Gm.**	290 gr.
Water	**10 mils**	5 fl. dr.
Glycerin	**80 Gm.**	4 fl. oz.

Triturate the starch with the water, until a homogeneous mixture is produced. Then gradually add this to the glycerin, contained in a

[1]The British Pharmacopœia (1914) uses the class title "Glycerinum" for preparations of this character.

porcelain dish, and heated to about 140° C. (284° F). Continue the heat, with constant stirring, keeping it below 144° C. (291.2° F.), until a translucent jelly is formed. Transfer the product to suitable vessels, provided with well-fitting covers.

GLYCERITUM BOROGLYCERINI. U. S. Glycerite of Boroglycerin

[Glycer. Boroglyc.]

	Metric	Old form
***Boric Acid,** in fine powder	**310 Gm.**	5 oz. av. 76 gr.
Glycerin, a sufficient quantity,		
To make	**1000 Gm.**	16 oz. av.

Heat 460 Gm. [old form 7 oz. av. 374 grains] of glycerin, in a tared porcelain dish on a sand bath, to a temperature between 140° C. and 150° C. (284° and 302° F.), and add the boric acid in portions, constantly stirring. When all is added and dissolved, continue the heat at the same temperature, frequently stirring, and breaking up the film which forms on the surface until the mixture has been reduced to the weight of 500 Gm. [old form 8 oz. av.], then add to it 500 Gm. [old form 8 oz. av.] of glycerin, mix thoroughly, and immediately transfer it to bottles and stopper them tightly.

When glycerin and boric acid are heated together in the proportion given in the formula, water is given off, the product thickens, requiring frequent stirring to break up the film which forms, and finally produces a hard, partially transparent, and very hygroscopic mass. This substance is called "boroglycerin" and when dissolved in an equal weight of glycerin constitutes the official Glycerite of Boroglycerin. Care must be observed throughout the operation to avoid an excess of heat which would cause a yellowish or brownish color.

N. F. Preparation.—Suppositoria Boroglycerini.

GLYCERITUM HYDRASTIS. U. S. Glycerite of Hydrastis

[Glycer. Hydrast. GLYCERITE OF GOLDEN SEAL]

One hundred mils of glycerite of hydrastis yields not less than 1.12 Gm. nor more than 1.37 Gm. of the ether-soluble alkaloids of hydrastis.

	Metric	Old form
***Hydrastis,** in No. 60 powder	**1000 Gm.**	25 oz. av.
Glycerin,		
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	24 fl. oz.

Moisten the hydrastis with 350 mils [old form 8½ fl. oz.] of alcohol, pack it firmly in a cylindrical percolator, and add enough alcohol to saturate the powder and leave a stratum above it. When the liquid

begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding alcohol, until the drug is exhausted. Remove nearly all of the alcohol by distillation or evaporation, pour the thick concentrated liquid into 450 mils [old form 10 fl. oz. 384 minims] of ice-cold water, and set it aside, in a cold place, for twenty-four hours. Then filter and assay a portion of this filtrate by the process given below, and, from the result thus obtained, ascertain by calculation the amount of ether-soluble alkaloids in the remainder of the liquid. Add to this enough cold water to make each 100 mils [old form 2 fl. oz. 192 minims] of the product contain 2.5 Gm. of the ether-soluble alkaloids of hydrastis. Finally add an equal volume of glycerin, and mix.

Assay.—Proceed as directed under *Fluidextractum Belladonnæ Radicis*, first line of the assay, modifying the process there given by using 5 mils of glycerite of hydrastis instead of 10 mils of fluidextract of belladonna root and using only ether as the immiscible solvent throughout the assay. Wash the final ether extractions with 10 mils of distilled water, draw off the water and discard it. Then filter the ether solution through a pledget of purified cotton, wash the cotton with ether, evaporate the filtrate and washings, and dry the residue at 100° C. (212° F.) to constant weight instead of titrating it. The weight represents the amount of ether-soluble alkaloids in 5 mils of the glycerite of hydrastis.

Average dose.—30 minims (2 mils).

GLYCERITUM PHENOLIS. U. S. Glycerite of Phenol

[Glycer. Phenol. GLYCERITE OF CARBOLIC ACID]

	Metric	Old form
***Liquefied Phenol**	**20 mils**	2 fl. oz.
Glycerin	**80 mils**	8 fl. oz.
To make	**100 mils**	10 fl. oz.

Add the liquefied phenol to the glycerin and thoroughly mix.

Average dose.—5 minims (0.3 mil).

GLYCERITUM BISMUTHI. N. F. Glycerite of Bismuth

[Glycer. Bism.]

One hundred milliliters of glycerite of bismuth yields not less than 12.8 Gm. of bismuth oxide.

	Metric	Old form
Bismuth Subnitrate	**160 Gm.**	5 oz. av. 149 gr.
Nitric Acid	**150 mils**	4 fl. oz. 384 min.
Tartaric Acid	**238 Gm.**	7 oz. av. 413 gr.
Sodium Bicarbonate	**334 Gm.**	11 oz. av. 65 gr.
Glycerin,		
Distilled Water, each, a sufficient quantity,		
To make about	**1000 mils**	2 pints

Mix the nitric acid with 300 mils [old form 9 fl. oz. 288 minims] of distilled water, in a bottle having a capacity of about 4000 mils [old form 1 gallon], and dissolve the bismuth subnitrate in the mixture. Then slowly add 600 mils [old form 19 fl. oz. 96 minims] of distilled

water and dissolve 119 Gm. [old form 3 oz. av. 425 grains] of tartaric acid in the mixture. Now add, in small portions, 200 Gm. [old form 6 oz. av. 296 grains] of sodium bicarbonate, shaking frequently and avoiding loss by effervescence, and when all is added fill the bottle with distilled water and mix well. Allow the magma to settle and decant the clear liquid. Again fill the bottle with distilled water and wash the magma by decantation as before, repeating the process until the wash-liquor has but a slightly saline taste. Then pour the magma upon a filter and allow it to drain, rinsing the bottle with a little distilled water.

Transfer the moist magma to a porcelain evaporating dish, add 119 Gm. [old form 3 oz. av. 425 grains] of tartaric acid and then slowly, and in small portions, 134 Gm. [old form 4 oz. av. 207 grains] of sodium bicarbonate. Heat the mixture on a steam bath until solution is effected and the total volume is reduced to 475 mils [old form 15 fl. oz. 96 minims]. Then add 475 mils [old form 15 fl. oz. 96 minims] of glycerin, and, if necessary, enough distilled water to make the solution measure 950 mils [old form 30 fl. oz. 192 minims] of solution, and filter. Estimate the amount of bismuth oxide in the liquid by the process given below and from the result thus obtained adjust the strength by evaporation or the addition of equal volumes of glycerin and water so that each 100 mils [old form 3 fl. oz. 183 minims] of the finished Glycerite will yield not less than 12.8 Gm. [old form 198 grains] of bismuth oxide.

This preparation provides a soluble form of bismuth which is more permanent than the official salt, bismuth and ammonium citrate. In this solution the bismuth is combined with sodium tartrate and the volatile ammonia is thus eliminated. The glycerite is used chiefly as a stock preparation from which the Solution and Elixirs of Bismuth are prepared. A scaled salt of bismuth and sodium tartrate has also become a commercial article. For a description and tests for this Solution see Part III.

N. F. Preparations.—Elixir Bismuthi; Elixir Cinchonæ Alkaloidorum, Ferri, et Bismuthi; Elixir Pepsini et Bismuthi; Liquor Bismuthi.

GLYCERITUM GUAIACI. N. F. Glycerite of Guaiac

[Glycer. Guaiac.]

	Metric	Old form
Guaiac, in powder	**85 Gm.**	2 oz. av. 366 gr.
Solution of Potassium Hydroxide	**65 mils**	2 fl. oz. 38 min.
Glycerin	**600 mils**	19 fl. oz. 96 min.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the solution of potassium hydroxide with 300 mils [old form 9 fl. oz. 288 minims] of water, add the powdered guaiac, and macerate the mixture during twenty-four hours with occasional agitation. Then filter, add the glycerin and sufficient water to make the product measure 1000 mils [old form 2 pints].

Average dose.—30 minims (2 mils).

GLYCERITUM PEPSINI. N. F. Glycerite of Pepsin
[Glycer. Pepsin.]

	Metric	Old form
Pepsin	**85 Gm.**	2 oz. av. 366 gr.
Hydrochloric Acid	**10 mils**	2½ fl. dr.
Purified Talc	**15 Gm.**	219 gr.
Glycerin	**500 mils**	1 pint
Distilled Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the pepsin with 350 mils [old form 11 fl. oz. 96 minims] of distilled water and the hydrochloric acid, and agitate the mixture until solution has been effected. Then incorporate the purified talc, filter, returning the first portions of the filtrate until it passes through clear, and add enough distilled water through the filter to make the product measure 500 mils [old form 1 pint]. To this add the glycerin and mix.

N. F. Preparations.—Elixir Cinchonæ Alkaloidorum, Ferri et Pepsini; Elixir Pepsini; Liquor Pepsini; Succus Citri et Pepsinum; Vinum Pepsini.

Average dose.—45 minims (3 mils).

GLYCERITUM PICIS LIQUIDÆ. N. F. Glycerite of Tar
[Glycer. Pic. Liq.]

	Metric	Old form
Tar	**63 Gm.**	2 oz. av. 45 gr.
Magnesium Carbonate	**125 Gm.**	4 oz. av. 76 gr.
Glycerin	**250 mils**	8 fl. oz.
Alcohol	**125 mils**	4 fl. oz.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Pour 200 mils [old form 6 fl. oz. 192 minims] of cold water upon the tar, contained in a mortar, mix them together thoroughly, allow the mixture to settle, and pour off the water. Repeat this operation until the washings show only a slightly acid reaction with litmus. Now triturate the washed tar with the alcohol, gradually incorporate the magnesium carbonate and glycerin, and then add 625 mils [old form 20 fl. oz.] of water. Pour the mixture upon a filter of loose texture, and, after the liquid portion has passed through, wash the residue on the filter with a mixture of one volume of alcohol and seven volumes of water, until the product measures 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

GLYCERITUM TRAGACANTHÆ. N. F. Glycerite of Tragacanth
[Glycer. Trag.]

	Metric	Old form
Tragacanth, in fine powder	**125 Gm.**	4 oz. av. 179 gr.
Glycerin	**775 mils**	26 fl. oz. 99 min.
Water	**185 mils**	6 fl. oz. 123 min.

Mix the tragacanth and glycerin thoroughly, add the water and stir the mixture until a homogeneous, thick paste results.

GLYCERITUM VITELLI. N. F. Glycerite of Egg Yolk

[Glycer. Vitell. GLYCONIN]

	Metric	Old form
Egg Yolk	45 Gm.	787.5 gr.
Glycerin	55 Gm.	962.5 gr.
To make	100 Gm.	4 oz. av.

Rub the yolk of egg in a mortar, with the glycerin, gradually added, until they are thoroughly mixed, and then strain the product.

N. F. Preparation.—Emulsum Olei Morrhuæ cum Vitello.

QUESTIONS ON AQUEOUS PREPARATIONS CONTAINING SWEET, VISCID, OR INSOLUBLE SUBSTANCES

What are syrups? (See page 317.)
What kinds of sugar should be used in making syrups?
How many methods of making syrups are recognized by the U. S. P.?
Describe the details for making syrups with the aid of heat. For making syrups by agitation without heat.
What objection is there to making syrups by the addition of fluid extracts, tinctures, etc., to syrup?
Name several official syrups which were formerly made by digestion?
Is this method a satisfactory one? What method is preferable?
How is the process of percolation in making syrups conducted?
What precautions are necessary to percolate a syrup successfully?
What is the objection to using a sponge in this process?
How may syrups be made by percolation on a large scale? How may syrups be preserved?
Is the addition of alcohol or chemicals objectionable? Why?
What is the best disposition to make of fermented syrups?
How may fruit juices be effectually preserved?
How many syrups are official in the U. S. P. ? How many in the N. F.?
Which of the U. S. P. syrups involve a chemical reaction during their preparation?
How many of the U. S. P. syrups are made by the simple addition of medicating liquid to syrup? Name them.
Which of these are made from acid? Which from tinctures? Which from fluidextracts?
Name the official syrups made by the agitation of sugar with medicating liquid without heat.
Which of these contains acetic acid?
Which one is made by cold aqueous infusion?
Which from medicated water from tincture?
Which from medicated water from fluidextract?
How many are made by maceration or digestion? Name them.
What U. S. P. syrups are made with the aid of heat?
Name the N. F. syrups made by the direct addition of a medicating liquid or solid to simple syrup. Those made by the solution of sugar by agitation without heat. Those in which heat is required to dissolve the sugar.
Give the formula and official methods for preparing Syrupus. What is its specific gravity?
How is syrup of acacia made?
What is the object of heating this syrup? Does this syrup keep well?
Give the formula and mode of making syrup of citric acid.
What is the formula in symbols of hydriodic acid? What is its molecular weight?
How is syrup of hydriodic acid made? How much hydriodic acid should it contain?
Give the process for making syrup of orange. Syrup of orange flowers.
What are the ingredients used in making syrup of calcium lactophosphate?
Give an outline of the process for making it. Write out in full the Latin name.
What is the formula in symbols of ferrous iodide? What is its molecular weight?
How is syrup of ferrous iodide prepared? How much ferrous iodide should it contain?

What hypophosphites are used in syrup of hypophosphites? How is the syrup prepared?
How is syrup of ipecac made?
How much ipecac is represented by two and a half troy ounces of the syrup?
About how much in a fluidounce? Write out the Latin name in full.
Give the formula for syrup of lactucarium.
Write out in full the Latin name for syrup of tar.
How much tar is used to make one hundred parts of the syrup?
How is the syrup made?
Write out in full the Latin name of syrup of wild cherry.
How much wild cherry is used to make one hundred parts?
What degree of fineness is directed for the powder? How is the syrup made?
How much glycerin does it contain? Why is this syrup made without heat?
What is the object of maceration for twenty-four hours prior to percolation?
Give the formula for syrup of rhubarb. How is the syrup made?
Give the formula and method for preparing aromatic syrup of rhubarb.
What are the ingredients of compound syrup of sarsaparilla? How is the syrup prepared?
Give the formula and method for preparing syrup of squill.
What are the ingredients of compound syrup of squill? How is this syrup prepared?
How much antimony and potassium tartrate is there in a troy ounce of the syrup?
What is its synonym? What is its dose?
Give the formula and method for making syrup of senega.
What aromatic is used in making syrup of senna? Why?
How is syrup of senna made?
How much senna is there in one hundred parts of syrup?
Give the formula and method for making syrup of tolu.
How is syrup of ginger made? What is its strength?
How is syrup of garlic of the N. F. made?
Name all U. S. P. and N. F. syrups containing hypophosphites.
What bromides are used in syrup of the bromides? What is the dose in grains, per teaspoonful, of the combined bromides, in this syrup?
How is syrup of calcium iodide prepared?
What amount of codeine is present in each teaspoonful of syrup of codeine?
Describe the process for making aromatic syrup of eriodictyon. Why is solution of potassium hydroxide used?
How is syrup of iron and manganese iodide prepared?
Why is potassium citrate used in making syrup of ferric hypophosphite?
Name the ingredients in compound syrup of figs.
How is syrup of glycyrrhiza made?
Name the ingredients in compound syrup of hypophosphites.
What is the synonym for syrup of iron, quinine and strychnine; for syrup of ipecac and opium; for syrup of morphine and acacia; for compound syrup of the phosphates.
Name the ingredients in compound syrup of white pine.
What is the English title for syrup of buckthorn berries?
Describe the process for making syrup of raspberry; for making syrup of blackberry fruit.
Name the N. F. medicated syrups prepared by mixing fluidextracts with syrup.
What acid is used in syrup of sanguinaria and why? In syrup of rose?
What are official honeys? How many are there in the U. S. P? How many in the N. F.? Name them.
Give the Latin name and official method for preparing commercial honey; clarified honey; honey of rose.
Name and give the ingredients in the N. F. honeys. What is oxymel of squill?
What are official mucilages, and how many are official in the U. S. P.? In the N. F.?
How many mucilages are prepared without heat? Name them.
How is mucilage of acacia prepared?
Give the Latin name, formula, and mode of making mucilage of sassafras pith; mucilage of tragacanth; mucilage of chondrus.
What are emulsions? How many are official in the U. S. P.? In the N. F.? Name them.
What were these preparations called in the U. S. P. before 1890?
Give the formula and method of making emulsion of almond; emulsion of asafetida; emulsion of cod liver oil; emulsion of oil of turpentine.

What is the popular name or synonym for emulsion of asafetida?
What flavors are recommended for emulsions by the N. F.?
Why is a selection of flavors offered?
Name the emulsions of the N. F. containing cod liver oil.
How is emulsion of petrolatum made?
What are official mixtures, and how many are official in the U. S. P.? How many in the N. F.?
Give the Latin name, formula, and method for making chalk mixture.
Why should chalk mixture be made extemporaneously?
How is compound mixture of glycyrrhiza made and what is its synonym?
What are the ingredients in "Godfrey's Cordial"?
What is the Latin title? How much opium is present?
What is "Stokes' Expectorant"? How much opium does it contain?
What are the ingredients in Dalby's carminative? What amount of opium is present?
Name the ingredients in chloroform anodyne.
How is compound iron mixture prepared? What form of iron should be present in the finished product? Why should it be freshly prepared?
How much opium is present in Dewees' carminative? What are the other ingredients?
Give the ingredients and the dose for "Squibb's Diarrhœa Mixture"; for "Sun Cholera Mixture."
Give the Latin name, formula, and method for preparing compound mixture of rhubarb.
What was the U. S. P. VIII name for this preparation?
What are magmas?
Name those official in the U. S. P. The one in the N. F.
What is the character of the superseded material in magmas?
Name the ingredients in compound gargle of guaiac.
What is the character of the N. F. preparations known as lotions?
How is "yellow wash" made? What are the Latin and English titles?
What is "black wash" and what are its official titles?
What are the ingredients in "lead and opium wash"?
Give the important characteristics of official glycerites.
How many are official in the U. S. P.? In the N. F.? Name them.
What are the ingredients and how is glycerite of tannic acid made? Glycerite of starch? Glycerite of boroglycerin?
Give the process for making glycerite of hydrastis. What should be its alkaloidal content?
What per cent. of phenol in the glycerite?
How is glycerite of bismuth made? What chemical combination of bismuth is present?
What preparations are made from glycerite of bismuth?
How is glycerite of pepsin made? Into what preparations does it enter?
What is "glyconin" and for what is it used?

CHAPTER XXIII

ALCOHOLIC SOLUTIONS

Spiritus *Spirits*

SPIRITS, from a pharmaceutical point of view, are simply *alcoholic* solutions of volatile substances. Like the medicated waters, the active ingredient may be solid, liquid, or gaseous. None are made by percolation, but they are officially prepared in five ways: 1. By simple solution. 2. By solution with maceration. 3. By gaseous solution. 4. By chemical reaction. 5. By distillation, although spirits made by this method are no longer official. There are *fifteen* spirits official in the U. S. P. IX and *eight* in the N. F. IV.

1. **By Simple Solution.**—This is the most usual method of making spirits; of the official preparations of this class, *twenty*, or all but three of the whole number, are prepared in this way, while *nine* of the twenty are merely solutions of volatile oils in alcohol of different strengths, without any other addition. No skill is required to make these, but a great deal of conscientious care must be used in the selection of the volatile oils, that they be of the best quality, and recently distilled. Filtration is usually unnecessary.

U. S. P. Spirits made by Simple Solution

Title	Ingredients	Method of Preparation, Use, and Dose
Spiritus Ætheris	325 mils Ether; Alcohol to make 1000 mils	Mix them. Stimulant, f 5 i (4 mils)
Ammoniæ Aromaticus	34 Gm. Ammonium Carbonate; 90 mils Ammonia Water; 10 mils Oil of Lemon; 1 mil Oil of Lavender; 1 mil Oil of Myristica; 700 mils Alcohol; Distilled Water, enough to make 1000 mils	Add the Ammonium Carbonate, in moderately fine powder, to the Ammonia Water and 140 mils of Distilled Water. Agitate until dissolved and allow to stand 12 hours. Mix the Alcohol and Oils, add slowly to Ammonium Carbonate solution, and then add enough Water to make 1000 mils. Filter after standing in a cool place for 24 hours. Antacid, 30 ♏ (2 mils)
Amygdalæ Amaræ	10 mils Oil of Bitter Almond; 800 mils Alcohol; Distilled Water, enough to make 1000 mils	Mix them. Flavor, 8 ♏ (0.5 mil)
Anisi	100 mils Oil of Anise; Alcohol, enough to make 1000 mils	Mix them. Carminative, 30 ♏ (2 mils)
Aurantii Compositus	200 mils Oil of Orange; 50 mils Oil of Lemon; 20 mils Oil of Coriander; 5 mils Oil of Anise; Alcohol, enough to make 1000 mils	Mix them. Flavor. Used in making Aromatic Elixir
Camphoræ	From 9.5 Gm. to 10.5 Gm. of Camphor in each 100 mils of Spirit. 100 Gm. Camphor; Alcohol, enough to make 1000 mils	Dissolve the Camphor in enough Alcohol to make 1000 mils. Stimulant, 15 ♏ (1 mil)
Chloroformi	60 mils Chloroform; Alcohol, enough to make 1000 mils	Mix them. Sedative, stimulant, 30 ♏ (2 mils)
Cinnamomi	100 mils Oil of Cinnamon; Alcohol, enough to make 1000 mils	Mix them. Stimulant, 30 ♏ (2 mils)
Glycerylis Nitratis	From 1 to 1.1 per cent. of Glyceryl Trinitrate in alcoholic solution	Cardiac stimulant, 1 ♏ (0.05 mil)
Juniperi	50 mils Oil of Juniper; Alcohol, enough to make 1000 mils	Mix them. Stimulant, Diuretic, 30 ♏ (2 mils)
Juniperi Compositus	8 mils Oil of Juniper; 1 mil Oil of Caraway; 1 mil Oil of Fennel; 1400 mils Alcohol; Water, enough to make 2000 mils	Dissolve the Oils in the Alcohol and add enough Water to make 1000 mils. Stimulant, Diuretic, f 3 ii ss (10 mils).
Lavandulæ	50 mils Oil of Lavender; Alcohol, enough to make 1000 mils	Mix them. Flavor, 30 ♏ (2 mils)

N. F. Spirits (All made by Simple Solution)

Title	Ingredients	Method of Preparation and Dose
Spiritus Acidi Formici	40 mils Formic Acid; 225 mils Distilled Water; Alcohol, enough to make 1000 mils	Mix the Formic Acid and Distilled Water and add enough Alcohol to make 1000 mils f 3 i (4 mils)
Ætheris Compositus	325 mils Ether; 650 mils Alcohol; 25 mils Ethereal Oil	Mix them, f 3 i (4 mils)
Ammoniæ Anisatus	30 mils Anethol; 200 mils Ammonia Water; Alcohol, enough to make 1000 mils	Mix the Anethol with 770 mils of Alcohol, add the Ammonia Water and enough Alcohol to make 1000 mils, 15 ℥ (1 mil)
Cardamomi Compositus	20 mils Oil of Cardamom; 20 mils Oil of Orange; 2 mils Oil of Cinnamon; 1 mil Oil of Clove; 1 mil Anethol; 0.1 mil Oil of Caraway; Alcohol, enough to make 200 mils	Mix the Oils with enough Alcohol to make 200 mils. Flavor for making Elixirs
Myrciæ Compositus	8 mils Oil of Myrcia; 0.5 mil Oil of Orange; 0.5 mil Oil of Pimenta; 610 mils Alcohol; Water, enough to make 1000 mils	Mix the Oils with the Alcohol, gradually add enough Water to make 1000 mils, set aside for 8 days, and filter
Odoratus	15 mils Oil of Bergamot; 8 mils Oil of Lemon; 7 mils Oil of Rosemary; 4 mils Oil of Lavender; 4 mils Oil of Orange Flowers; 2 mils Acetic Ether; 120 mils Water; 840 mils Alcohol	Dissolve the Oils and the Acetic Ether in the Alcohol, add the Water, set it aside for 8 days and filter
Sinapis	2 mils Volatile Oil of Mustard; Alcohol, enough to make 100 mils	Mix them
Vanillini Compositus	40 Gm. Vanillin; 10 mils Oil of Orange; 2 mils Oil of Cardamom; 1 mil Oil of Cinnamon; Alcohol, enough to make 200 mils	Mix the Vanillin and Oils with enough Alcohol to make 200 mils. Flavor for making Elixirs

2. **Solution with Maceration.**—This method is employed when it is desirable to introduce the coloring matter of the drug into the preparation. This has been done in order to bestow individuality, and in deference to popular feeling in favor of high colors. It is very doubtful whether either object is worthy of consideration.

U. S. P. Spirits made by Solution with Maceration

Title	Ingredients	Method of Preparation, Use, and Dose
Spiritus Menthæ Piperitæ	100 mils Oil of Peppermint; 10 Gm. Peppermint, bruised; Alcohol, enough to make 1000 mils	Macerate the Peppermint for 1 hour in 500 mils of Water, strongly express, add the macerated leaves to 800 mils of Alcohol, containing the Oil, and then enough Alcohol to make 1000 mils. Macerate for 6 hours, with frequent agitation and filter. Carminative, 30 ℥ (2 mils)
Menthæ Viridis	100 mils Oil of Spearmint; 10 Gm. Spearmint, bruised; Alcohol, enough to make 1000 mils	Prepare as directed for Spirit of Peppermint

3. **By Gaseous Solution.**—The only representative of this class, Spirit of Ammonia, was transferred to the list of reagents of the U. S. P. IX. It is made by converting a gaseous aqueous solution into a gaseous alcoholic solution by expelling the dissolved gas from water by heat and causing it to be redissolved in alcohol. The spirit is assayed by the use of normal volumetric solution of sulphuric acid, and brought to the standard strength of 10 per cent., by weight, of gaseous ammonia.

Unofficial Spirit made by Gaseous Solution

Title	Ingredients	Method of Preparation
Spiritus Ammoniæ U. S. P. VIII	250 mils Stronger Ammonia Water; Alcohol, a sufficient quantity	Heat the Stronger Ammonia Water, not above 60° C. (140° F.), in a flask, connected by means of a glass condenser, with a well-cooled receiver containing 500 mils of Alcohol, the delivery tube reaching nearly to the bottom of the condenser. When all Ammonia has been distilled, adjust the volume of the Spirit to contain 10 per cent., by weight, of Ammonia Gas. Stimulant, 5 to 30 ℥ (0.3 to 2 mils)

4. **By Chemical Reaction.**—There is but *one* spirit in the Pharmacopœia made by chemical reaction, and that is Spirit of Nitrous Ether. As explained elsewhere (Part IV), it is the product resulting from a reaction between sodium nitrite, sulphuric acid and alcohol, and the ethyl nitrite so produced is dissolved in alcohol.

U. S. P. Spirit made by Chemical Reaction

Title	Ingredients	Method of Preparation, Use, and Dose
Spiritus Ætheris Nitrosi	From 3.5 to 4.5 per cent. of Ethyl Nitrite. 100 Gm. Sodium Nitrite; 40 mils Sulphuric Acid; 0.6 Gm. Monohydrated Sodium Carbonate; 3 Gm. Potassium Carbonate, Alcohol and Water, each, a sufficient quantity	Dissolve the Sodium Nitrite in 280 mils of Water, slowly drop the solution into a cold mixture of the Sulphuric Acid, 120 mils of Water, and 85 mils of Alcohol. Separate the Ethyl Nitrite from the aqueous layer, wash it with ice water, then with the Sodium Carbonate, dissolved in 15 mils of ice water, and dry it by shaking with the Potassium Carbonate. Finally mix the purified Ethyl Nitrite with enough Alcohol to make the product weigh 22 times the weight of the Ethyl Nitrite added. Use ice freely in this process, as Ethyl Nitrite boils at about 16.4° C. (61.5° F.). Diaphoretic, diuretic f 5 ss to f 5 i (2 mils to 4 mils)

5. **By Distillation.**—This method of making spirits is the oldest and in many respects the best in use. When the desirable volatile principles which are present in the preparation when finished can be vaporized at the temperature of boiling alcohol or diluted alcohol, distillation is preferred. In the case of liquids containing some oils of high boiling points, it is necessary to obtain the oils by distillation with water and afterwards mix the distillate with alcohol. It is certain, however, that spirits made by the admixture of volatile oils with alcohol, as in Class 1, are often deficient in the more delicate and volatile principles found in the substances from which they are distilled. These principles are often soluble in water and insoluble in the oil, and necessarily, in the distillation of the volatile oil with water, they must be found in the water, and are absent from the oil. This is well illustrated by a comparison of oil of neroli and orange flower water; the latter has much the more fragrant odor when compared with the oil obtained in the same distillation from the same flowers and subjected to the same temperature. The two spirits of the U. S. P. VIII which were made by distillation have been omitted from the U. S. P. IX; they were Whisky and Brandy.

Unofficial Spirits

Title	Ingredients	Method of Preparation, Use, and Dose
Spiritus Ammoniæ Fetidus. Br.	75 Gm. Asafetida; 100 mils Strong Solution of Ammonia (32.5 per cent.); Alcohol (90 per cent.), enough to make 1000 mils	Macerate the Asafetida in 750 mils Alcohol for twenty-four hours, distil off the Alcohol; mix the distillate with the Strong Solution of Ammonia and enough Alcohol to make 1000 mils
Armoraciæ Compositus. Br.	125 Gm. Horseradish Root, scraped; 125 Gm. Dried Bitter Orange Peel; 3 Gm. Nutmeg; 625 mils Alcohol; (90 per cent.) 750 mils Distilled Water	Mix, macerate one hour, and distil 1000 mils
Aurantii. U. S. P. 1890	50 mils Oil of Orange Peel; 950 mils Alcohol	Mix them
Cajuputi. Br.	100 mils Oil of Cajuput; Alcohol, enough to make 1000 mils	Mix them. If not clear, shake with Talc and filter
Frumenti. U. S. P. VIII	By distillation from fermented mash of grain; must be at least four years old	Stimulant, f ʒ iv to f ʒ i (15 to 30 mils)
Gaultheriæ. U.S.P.VIII	50 mils Oil of Gaultheria; 950 mils Alcohol	Mix them
Limonis. U. S. P. 1890	50 mils Oil of Lemon; 50 Gm. freshly grated Lemon Peel; Alcohol, enough to make 1000 mils	Mix the Oil with 900 mils Alcohol, add the Lemon Peel, and macerate during twenty-four hours. Filter and add enough Alcohol to make 1000 mils
Myristicæ. U.S.P.1890	50 mils Oil of Myristica; 950 mils Alcohol	Mix them
Phosphori. U.S.P.1890	1.2 Gm. Phosphorus; Dehydrated Alcohol, enough to make 1000 mils	Add the carefully weighed Phosphorus to 1000 mils of Dehydrated Alcohol contained in a flask; connect with upright condenser and boil the liquid until the Phosphorus is dissolved; then, if necessary, add enough Dehydrated Alcohol to make 1000 mils and preserve in small, tightly-stoppered bottles
Rectificatus. Br.	A liquid containing 90 parts, by volume, of Ethyl Hydroxide, and 10 parts, by volume, of Water	Obtained by distillation of fermented saccharine liquids
Rosmarini. Br.	100 mils Oil of Rosemary; Alcohol, enough to make 1000 mils	Mix them. If not clear, shake with Talc and filter
Vini Gallici. U.S.P.VIII	By distillation from fermented juice of grapes; must be at least four years old	Stimulant, f ʒ iv to f ʒ i (15 to 30 mils)

SPIRITUS ÆTHERIS. U. S. Spirit of Ether

[Sp. Æth. HOFFMANN'S DROPS]

	Metric	Old form
***Ether**	**325 mils**	5 fl. oz. 96 min.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	1 pint

Mix the ether with a sufficient quantity of alcohol to make the product measure 1000 mils [old form 1 pint].

Average dose.—1 fluidrachm (4 mils).

SPIRITUS ÆTHERIS NITROSI. U. S. Spirit of Nitrous Ether

[Sp. Æth. Nitros. SWEET SPIRIT OF NITRE]

An alcoholic solution of ethyl nitrite [$C_2H_5NO_2 = 75.05$], containing not less than 3.5 per cent. nor more than 4.5 per cent. of $C_2H_5NO_2$. Preserve it in small, well-stoppered, dark amber-colored bottles, in a cool and dark place, remote from fire.

	Metric	Old form
*Sodium Nitrite	100.0 Gm.	3 oz. av. 148 gr.
Sulphuric Acid	40.0 mils	1 fl. oz. 134 min.
Monohydrated Sodium Carbonate	0.6 Gm.	9 gr.
Potassium Carbonate, completely deprived of water by heating	3.0 Gm.	44 gr.
Alcohol,		
Water, each, a sufficient quantity.		

Mix the sulphuric acid with 120 mils [old form 4 fl. oz.] of water, cool the liquid, add 85 mils [old form 2 fl. oz. 6 fl. dr.] of alcohol previously diluted with an equal volume of water, and introduce the solution into a 1000-mil flask, surrounded by a mixture of ice and water. Dissolve the sodium nitrite in 280 mils [old form 9 fl. oz.] of water, filter, and, having poured the filtrate into a separatory funnel, allow the liquid to slowly drop into the flask containing the acid mixture. When all has been added and the reaction is complete, allow any crystals which may have formed to settle at the bottom of the flask, and decant the cold mixture of ethyl nitrite and aqueous solution quickly to the previously cooled separatory funnel, and draw off and discard the aqueous liquid. Wash the separated ethyl nitrite, first, with 20 mils [old form 5 fl. dr. 7 minims] of ice-cold water, and then remove any traces of acid by washing it with 15 mils [old form 4 fl. dr.] of ice-cold water, in which the monohydrated sodium carbonate has previously been dissolved. Carefully separate the ethyl nitrite from the aqueous liquid, and agitate it in a well-stoppered bottle with the potassium carbonate to remove traces of water. Then cool the liquid, decant, and pour the ethyl nitrite immediately into a tared bottle containing 500 Gm. [old form 16 oz. av. 302 grains] of alcohol. Ascertain the weight of the ethyl nitrite poured into the alcohol by noting the increase in weight of the tared bottle and contents, and then add enough alcohol to make the mixture weigh *twenty-two times* the weight of the ethyl nitrite added. Lastly, transfer the product to small, well-stoppered, dark amber-colored bottles, and keep these in a cool place, remote from fire.

(For tests and comments see Part IV.)

U. S. P. Preparation.—Mistura Glycyrrhizæ Composita.

N. F. Preparations.—Mistura Copaibæ; Mistura Copaibæ et Opii.

Average dose.—30 minims (2 mils).

SPIRITUS AMMONIÆ AROMATICUS. U. S. Aromatic Spirit of Ammonia

[Sp. Ammon. Arom.]

	Metric	Old form
*Ammonium Carbonate, in translucent pieces	34 Gm.	1 oz. av. 59 gr.
Ammonia Water	90 mils	2 fl. oz. 7 fl. dr.
Oil of Lemon	10 mils	2½ fl. dr.
Oil of Lavender	1 mil	15 min.
Oil of Myristica	1 mil	15 min.
Alcohol	700 mils	22 fl. oz. 3 fl. dr.
Distilled Water, a sufficient quantity,		
To make	1000 mils	2 pints

To the ammonia water, contained in a flask, add 140 mils [old form 4½ fl. oz.] of distilled water, and afterwards the ammonium carbon-

ate reduced to a moderately fine powder. Close the flask and agitate the contents until the ammonium carbonate is dissolved and allow it to stand for twelve hours. Introduce the alcohol into a graduated bottle of suitable capacity, add first the oils, then gradually the solution of ammonium carbonate, and afterwards enough distilled water to make the product measure 1000 mils [old form 2 pints]. Set the liquid aside during twenty-four hours in a cool place, occasionally agitating it, and then filter through paper, in a well-covered funnel.

Preserve the product in glass-stoppered bottles, in a cool place.

As ordinarily prepared, from unselected ammonium carbonate, precipitation is very apt to take place; this is due to the use of exposed and effloresced ammonium carbonate, which contains more than the proper quantity of bicarbonate (see Ammonii Carbonas). The addition of ammonia water in the formula is to convert the bicarbonate into the carbonate, the latter being soluble in the mixture of water and alcohol, while the bicarbonate is insoluble in alcohol. Sufficient time should be given to effect the solution. The ammonium carbonate should be carefully selected, and only the translucent pieces used.

(For tests see Part III.)

U. S. P. Preparations.—Tinctura Guaiaci Ammoniata; Tinctura Valerianæ Ammoniata.

N. F. Preparations.—Liquor Sodæ et Menthæ; Tinctura Kino et Opii Composita.

Average dose.—30 minims (2 mils).

SPIRITUS AMYGDALÆ AMARÆ. U. S. Spirit of Bitter Almond
[Sp. Amygd. Amar.]

	Metric	Old form
***Oil of Bitter Almond**	**10 mils**	154 min.
Alcohol	**800 mils**	25½ fl. oz.
Distilled Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the oil in the alcohol, and add enough distilled water to make the product measure 1000 mils [old form 2 pints].

NOTE.—This Spirit is intended for medicinal use; it must not be used for flavoring foods.

N. F. Preparations.—Elixir Anisi; Elixir Terpini Hydratis; Elixir Zinci Valeratis.

Average dose.—8 minims (0.5 mil).

SPIRITUS ANISI. U. S. Spirit of Anise
[Sp. Anisi]

	Metric	Old form
***Oil of Anise**	**100 mils**	1 fl. oz.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	10 fl. oz.

Mix the oil with sufficient alcohol to make the product measure 1000 mils [old form 10 fl. oz.].

Average dose.—30 minims (2 mils).

SPIRITUS AURANTII COMPOSITUS. U. S. Compound Spirit of Orange

[Sp. Aur. Co.]

	Metric	Old form
*Oil of Orange	200 mils	6 fl. oz. 3 fl. dr.
Oil of Lemon	50 mils	1 fl. oz. 5 fl. dr.
Oil of Coriander	20 mils	5 fl. dr.
Oil of Anise	5 mils	77 min.
Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Mix them. Keep the product in completely filled, well-stoppered bottles, in a cool and dark place.

U. S. P. Preparation.—Elixir Aromaticum.

N. F. Preparations.—Elixir Calcii Lactophosphatis; Elixir Ferri, Quininæ et Strychninæ; Elixir Phosphori; Vinum Carnis; Vinum Carnis et Ferri.

SPIRITUS CAMPHORÆ. U. S. Spirit of Camphor

[Sp. Camph.]

One hundred mils of Spirit of Camphor yields not less than 9.5 Gm., nor more than 10.5 Gm. of camphor.

	Metric	Old form
*Camphor	100 Gm.	3 oz. av. 148 gr.
Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the camphor in 800 mils [old form 25½ fl. oz.] of alcohol, filter through paper, and pass enough alcohol through the filter to make the product measure 1000 mils [old form 2 pints].

Impurities and Tests for Impurities.—Added Water. Add 0.05 Gm. of anhydrous potassium carbonate to 5 mils of Spirit of Camphor; the potassium carbonate does not liquefy or adhere to the bottom of the vessel.

Assay.—Fill a two-hundred millimeter polariscope tube with the Spirit of Camphor and take the mean of four or more readings of the rotation, beginning at zero each time. The temperature correction for each degree is half a minute, additive if above, subtractive if below, 25° C. (77° F.). Evaporate 60 mils of the Spirit of Camphor in a dish, on a water bath, and when the camphor begins to solidify stir it with a glass rod until dry. Then transfer the camphor to a watch glass, cover it with an inverted funnel and place the watch glass on wire gauze 10 cm. above a Bunsen burner having a flame 4 cm. high. When the camphor has all sublimed, dissolve 2.5 Gm. of the sublimate in sufficient alcohol (which must be of about 95 per cent. by volume) to make exactly 25 mils and take the mean of four or more polariscope readings as before. The minutes of rotation of the Spirit of Camphor divided by the minutes of rotation of the control test just made, and this multiplied by 10, shows the number of grammes of camphor in 100 mils of the Spirit of Camphor.

N. F. Preparations.—Lotio Ammoniacalis Camphorata; Mistura Opii et Chloroformi Composita; Mistura Opii et Rhei Composita; Tinctura Kino et Opii Composita; Tinctura Pectoralis.

Average dose.—15 minims (1 mil).

SPIRITUS CHLOROFORMI. U. S. Spirit of Chloroform

[Sp. Chlorof.]

	Metric	Old form
*Chloroform	60 mils	1 fl. oz. 7½ fl. dr.
Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the chloroform with sufficient alcohol to make the product measure 1000 mils [old form 2 pints].

Average dose.—30 minims (2 mils).

SPIRITUS CINNAMOMI. U. S. Spirit of Cinnamon

[Sp. Cinnam.]

	Metric	Old form
*Oil of Cinnamon	100 mils	1 fl. oz.
Alcohol, a sufficient quantity,		
To make	1000 mils	10 fl. oz.

Mix the oil with sufficient alcohol to make the product measure 1000 mils [old form 10 fl. oz.].

U. S. P. Preparation.—Syrupus Rhei.
N. F. Preparation.—Syrupus Ipecacuanhæ et Opii.

Average dose.—30 minims (2 mils).

SPIRITUS GLYCERYLIS NITRATIS. U. S. Spirit of Glyceryl Trinitrate

[Sp. Glyceryl. Nit. Spirit of Glonoin Spirit of Nitroglycerin]

An alcoholic solution containing not less than 1 per cent. nor more than 1.1 per cent. of $C_3H_5(NO_3)_3$ (227.07). Preserve it in well stoppered bottles in a cool, dark place, remote from fire.

Great care must be exercised in dispensing, handling, packing, transporting, and storing this Spirit, since a dangerous explosion may result if any considerable quantity of it is spilled, and the alcohol wholly or partly lost by evaporation. If, through accident, it is spilled, a solution of potassium hydroxide must be poured over it at once to effect partial decomposition.

Official Description.—A clear, colorless liquid.

Odor, Taste, and Reaction.—It has the odor of alcohol. *Caution must be exercised in tasting it,* since even a small quantity is liable to produce a violent headache. The same effect is produced when it is applied to the skin; neutral to litmus.

Specific Gravity.—0.814 to 0.820 at 25° C. (77° F.).

Tests for Identity.—Heat about 10 mils of Spirit of Glyceryl Trinitrate on a water bath with 1 mil of potassium hydroxide T.S. until the alcohol is evaporated, and then heat a portion of the residue with about 0.5 Gm. of potassium bisulphate; the pungent odor of acrolein is evolved. Dissolve the remainder of the residue in 2 mils of distilled water acidulated with diluted sulphuric acid, add a few drops of diphenylamine T.S. and pour the solution upon 2 mils of sulphuric acid in a test tube so as to form a separate layer; a dark blue color is produced at the zone of contact.

Mix 10 mils of the Spirit with 11 mils of distilled water, both previously cooled to 15° C. (59° F.); a clear solution results. On now adding 2 mils more of distilled water, the mixture, at 15° C. (59° F.), becomes turbid.

Assay.—Weigh accurately not more than about 5 mils of the Spirit, allow it to evaporate spontaneously in a tared dish protected from dust, and dry the residue to constant weight, in a desiccator, over sulphuric acid. The weight of the residue corresponds to not less than 1 per cent. nor more than 1.1 per cent. of the weight of Spirit taken.

Average dose.—1 minim (0.05 mil).

SPIRITUS JUNIPERI. U. S. Spirit of Juniper

[Sp. Junip.]

	Metric	Old form
*Oil of Juniper	50 mils	1 fl. oz.
Alcohol, a sufficient quantity,		
To make	1000 mils	20 fl. oz.

Mix the oil with sufficient alcohol to make the product measure 1000 mils [old form 20 fl. oz.].

Average dose.—30 minims (2 mils).

SPIRITUS JUNIPERI COMPOSITUS. U. S. Compound Spirit of Juniper
[Sp. Junip. Co.]

	Metric	Old form
*Oil of Juniper	8 mils	30 min.
Oil of Caraway	1 mil	4 min.
Oil of Fennel	1 mil	4 min.
Alcohol	1400 mils	11 fl. oz.
Water, a sufficient quantity,		
To make	2000 mils	1 pint

Dissolve the oils in the alcohol, and gradually add enough water to make the product measure 2000 mils [old form 1 pint].

Average dose.—2½ fluidrachms (10 mils).

SPIRITUS LAVANDULÆ. U. S. Spirit of Lavender
[Sp. Lavand.]

	Metric	Old form
*Oil of Lavender	50 mils	1 fl. oz.
Alcohol, a sufficient quantity,		
To make	1000 mils	20 fl. oz.

Mix the oil with sufficient alcohol to make the product measure 1000 mils [old form 20 fl. oz.].

N. F. Preparation.—Mistura Ferri Composita.

Average dose.—30 minims (2 mils).

SPIRITUS MENTHÆ PIPERITÆ. U. S. Spirit of Peppermint
[Sp. Menth. Pip. Essence of Peppermint]

	Metric	Old form
*Oil of Peppermint	100 mils	3 fl. oz. 96 min.
Peppermint, bruised	10 Gm.	146 gr.
Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Macerate the peppermint leaves, freed as much as possible from stems, during one hour in 500 mils [old form 1 pint] of water and then strongly express them. Mix 800 mils [old form 25 fl. oz. 288 minims] of alcohol with the oil, add the macerated leaves and enough alcohol to make 1000 mils [old form 2 pints], macerate the mixture during six hours, with frequent agitation, and then filter it. Preserve the product in amber-colored bottles.

N. F. Preparations.—Elixir Catharticum Compositum; Liquor Phosphori; Mistura Opii et Rhei Composita; Mistura Rhei Alkalina; Mistura Rhei Composita; Syrupus Ficorum Compositus.

Average dose.—30 minims (2 mils).

SPIRITUS MENTHÆ VIRIDIS. U. S. Spirit of Spearmint

[Sp. Menth. Vir.]

	Metric	Old form
*Oil of Spearmint	100 mils	3 fl. oz. 96 min.
Spearmint, bruised	10 Gm.	146 gr.
Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Macerate the spearmint leaves, freed as much as possible from stems, during one hour in 500 mils [old form 1 pint] of water and then strongly express them. Mix 800 mils [old form 25 fl. oz. 288 minims] of alcohol with the oil, add the macerated leaves and enough alcohol to make 1000 mils [old form 2 pints], macerate the mixture during six hours, with frequent agitation, and then filter it. Preserve the product in amber-colored bottles.

Average dose.—30 minims (2 mils).

SPIRITUS ACIDI FORMICI. N. F. Spirit of Formic Acid

[Sp. Ac. Formic. Spiritus Formicarum Spirit of Ants]

	Metric	Old form
Formic Acid	40 mils	1 fl. oz. 134 min.
Distilled Water	225 mils	7 fl. oz. 96 min.
Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the formic acid with the distilled water, and add enough alcohol to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

SPIRITUS ÆTHERIS COMPOSITUS. N. F. Compound Spirit of Ether

(U. S. P. VIII)

[Sp. Æther. Co. Hoffmann's Anodyne]

	Metric	Old form
Ether	325 mils	10 fl. oz. 192 min.
Alcohol	650 mils	20 fl. oz. 384 min.
Ethereal Oil	25 mils	384 min.
To make about	1000 mils	2 pints

Mix them.

Average dose.—1 fluidrachm (4 mils).

SPIRITUS AMMONIÆ ANISATUS. N. F. Anisated Spirit of Ammonia

[Sp. Ammon. Anis. Liquor Ammoniæ Anisatus Anisated Solution of Ammonia]

	Metric	Old form
Anethol	30 mils	461 min.
Ammonia Water	200 mils	6 fl. oz. 192 min.
Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the anethol in 770 mils [old form 24 fl. oz. 307 minims] of alcohol, gradually add the ammonia water and then sufficient alcohol to make the product measure 1000 mils [old form 2 pints].

Average dose.—15 minims (1 mil).

SPIRITUS CARDAMOMI COMPOSITUS. N. F. **Compound Spirit of Cardamom**
[Sp. Card. Co.]

	Metric	Old form
Oil of Cardamom	**20.0 mils**	384 min.
Oil of Orange	**20.0 mils**	384 min.
Oil of Cinnamon	**2.0 mils**	38 min.
Oil of Clove	**1.0 mil**	19 min.
Anethol	**1.0 mil**	19 min.
Oil of Caraway	**0.1 mil**	2 min.
Alcohol, a sufficient quantity,		
To make	**200 mils**	8 fl. oz.

Mix the oils with 140 mils [old form 5 fl. oz. 288 minims] of alcohol, and add sufficient alcohol to make the product measure 200 mils [old form 8 fl. oz.].

This spirit is used only as a flavor.

N. F. Preparations.—Elixir Cardamomi Compositum; Elixir Formatum Compositum; Elixir Gentianæ; Elixir Gentianæ et Ferri; Elixir Gentianæ et Ferri Phosphatis; Elixir Glycerophosphatum Compositum; Elixir Glycyrrhizæ Aquosum; Elixir Hypophosphitum; Liquor Pancreatini.

SPIRITUS MYRCIÆ COMPOSITUS. N. F. **Compound Spirit of Myrcia**
[Sp. Myrciæ Co.]

	Metric	Old form
Oil of Myrcia	**8.0 mils**	123 min.
Oil of Orange	**0.5 mil**	8 min.
Oil of Pimenta	**0.5 mil**	8 min.
Alcohol	**610.0 mils**	19 fl. oz. 250 min.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the oils with the alcohol, and gradually add water until the solution measures 1000 mils [old form 2 pints]. Set the mixture aside in a well-stoppered bottle, for eight days, and then filter it through paper in a covered funnel.

This preparation is commonly called *Bay Rum.*

SPIRITUS ODORATUS. N. F. **Perfumed Spirit**
[Sp. Odorat.]

	Metric	Old form
Oil of Bergamot	**15 mils**	4 fl. dr.
Oil of Lemon	**8 mils**	123 min.
Oil of Rosemary	**7 mils**	108 min.
Oil of Lavender	**4 mils**	1 fl. dr.
Oil of Orange Flowers	**4 mils**	1 fl. dr.
Acetic Ether	**2 mils**	31 min.
Water	**120 mils**	3 fl. oz. 403 min.
Alcohol	**840 mils**	26 fl. oz. 422 min.
To make about	**1000 mils**	2 pints

Dissolve the oils and the acetic ether in the alcohol, and add the water. Set the mixture aside, in a stoppered bottle, during eight days, and then filter it through paper in a covered funnel.

This is a typical formula for the preparation sold as *Cologne Water.*

SPIRITUS OLEORUM VOLATILUM. N. F. **Spirits of Volatile Oils**

Any spirit of a volatile oil, for which no formula is provided, may be prepared by the following general formula:

	Metric	Old form
The Volatile Oil	**65 mils**	2 fl. oz. 38 min.
Alcohol	**935 mils**	29 fl. oz. 442 min.
To make	**1000 mils**	2 pints

Dissolve the volatile oil in the alcohol.

SPIRITUS SINAPIS. N. F. **Spirit of Mustard**

[Sp. Sinap.]

Volatile Oil of Mustard	**2 mils**	31 min.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix them.

SPIRITUS VANILLINI COMPOSITUS. N. F. **Compound Spirit of Vanillin**

[Sp. Vanil. Co.]

	Metric	Old form
Vanillin	**40 Gm.**	1 oz. av. 293 gr.
Oil of Orange	**10 mils**	192 min.
Oil of Cardamom	**2 mils**	38 min.
Oil of Cinnamon	**1 mil**	19 min.
Alcohol, a sufficient quantity,		
To make	**200 mils**	8 fl. oz.

Dissolve the vanillin and the oils in 150 mils [old form 6 fl. oz.] of alcohol and then add sufficient alcohol to make the product measure 200 mils [old form 8 fl. oz.]. Store the spirit in tightly-stoppered, amber-colored bottles, in a cool place, protected from light. It is used exclusively as a flavor.

N. F. Preparations.—Elixir Vanillini Compositum; Syrupus Ammonii Hypophosphitis.

Elixiria *Elixirs*

Elixirs are aromatic, sweetened, spirituous preparations, frequently used as flavors and adjuvants in prescriptions and sometimes containing active medicinal substances. Although they are largely employed throughout the United States, but two have been made official in the U. S. P. IX. These are intended as vehicles for the administration of active remedies in small doses. The National Formulary IV, however, has recognized a large number of preparations of this class; in the group are *ten* intended for use as vehicles or adjuvants, and *sixty-six* which are medicated, a total of *seventy-six*. Elixirs, when dispensed, should always be brilliantly clear, filtration through purified talc, or preferably purified siliceous earth, being resorted to, if necessary. The utmost care should be taken in the selection of the flavoring ingredients and especially is this necessary with reference to the volatile oils, only those which are of finest quality and entirely free from deterioration products should be employed.

Elixirs of the U. S. P. IX

Title	Ingredients	Method of Preparation
Elixir Aromaticum	12 mils Compound Spirit of Orange; 375 mils Syrup; 30 Gm. Purified Talc; Alcohol and Distilled Water, each, enough to make 1000 mils	Add enough Alcohol to the Compound Spirit to make 250 mils. To this add the Syrup, 375 mils of Distilled Water, and the Talc, and filter. Finally wash the filter with enough Alcohol, 1 volume, Distilled Water, 3 volumes, to make 1000 mils
Glycyrrhizæ	125 mils Fluidextract of Glycyrrhiza; 875 mils Aromatic Elixir	Mix and filter

Elixirs of the N. F. IV

Title	Ingredients	Method of Preparation
Vehicles or Adjuvants		
Elixir Amygdalæ Compositum	0.5 mil Oil of Bitter Almond; 1 Gm. Vanillin; 150 mils Stronger Orange Flower Water; 50 mils Alcohol; 400 mils Syrup; 20 Gm. Purified Talc; Distilled Water, enough to make 1000 mils	Dissolve the Oil and Vanillin in the Alcohol, add the Syrup, Stronger Orange Flower Water and enough Distilled Water to make 1000 mils. Then incorporate the Talc and filter
Anisi	3.5 mils Anethol; 0.5 mil Oil of Fennel; 12 mils Spirit of Bitter Almond; 240 mils Alcohol; 625 mils Syrup; 20 Gm. Purified Talc; Distilled Water, enough to make 1000 mils	Mix the Oil, Anethol, and Spirit with the Alcohol, add the Syrup and enough Distilled Water to make 1000 mils. Then incorporate the Talc and filter after 12 hours, at 15° C. (59° F.)
Aromaticum Rubrum	2 Gm. Cudbear; 1000 mils Aromatic Elixir	Macerate the Cudbear with the Aromatic Elixir during 6 hours and filter
Aurantii Amari	4 mils Oil of Bitter Almond; 20 mils Tincture of Bitter Orange Peel; 300 mils Alcohol; 20 mils Stronger Orange Flower Water, 400 mils Syrup; 20 Gm. Purified Talc; Distilled Water, enough to make 1000 mils	Mix the Oil and Tincture with the Alcohol, add the Syrup and Stronger Orange Flower Water, and enough Distilled Water to make 1000 mils. Then incorporate the Talc and filter
Cardamomi Compositum	10 mils Compound Spirit of Cardamom; 90 mils Alcohol; 400 mils Syrup; 20 Gm. Purified Talc; Distilled Water, enough to make 1000 mils	Mix the Compound Spirit with the Alcohol, add the Syrup and enough Distilled Water to make 1000 mils. Then incorporate the Talc and filter
Eriodictyi Aromaticum	60 mils Fluidextract of Eriodictyon; 500 mils Syrup; 30 Gm. Pumice; 10 Gm. Magnesium Carbonate; 440 mils Compound Elixir of Taraxacum	Triturate the Fluidextract with the Pumice and Magnesium Carbonate and gradually add the Elixir and the Syrup. Shake the mixture frequently during 2 hours, allow to stand for 12 hours, and filter
Glycyrrhizæ Aquosum	150 mils Fluidextract of Glycyrrhiza; 5 mils Compound Spirit of Cardamom; 200 mils Stronger Orange Flower Water; 150 mils Glycerin; 150 mils Syrup; Distilled Water, enough to make 1000 mils	Mix and filter
Glycyrrhizæ Aromaticum	125 mils Fluidextract of Glycyrrhiza; 0.75 mil Oil of Clove; 0.75 mil Oil of Cinnamon; 0.5 mil Oil of Myristica; 1.5 mils Oil of Fennel; 20 Gm. Purified Talc; Aromatic Elixir, enough to make 1000 mils	Triturate the Oils with the Talc, gradually add the Fluidextract and enough Distilled Water to make 1000 mils. After 12 hours filter the product
Taraxaci Compositum	35 mils Fluidextract of Taraxacum; 20 mils Fluidextract of Wild Cherry; 60 mils Fluidextract of Glycyrrhiza; 60 mils Tincture of Sweet Orange Peel; 30 mils Tincture of Cinnamon; 30 mils Compound Tincture of Cardamom; Aromatic Elixir, enough to make 1000 mils	Mix the Fluidextracts, add the Tinctures and enough Aromatic Elixir to make 1000 mils. After 12 hours filter the product
Vanillini Compositum	20 mils Compound Spirit of Vanillin; 80 mils Alcohol; 25 mils Glycerin; 300 mils Syrup; 20 Gm. Purified Talc; 20 mils Tincture of Caramel; Distilled Water, enough to make 1000 mils	Mix the Compound Spirit with the Alcohol, add the Glycerin, then the Syrup, and 555 mi's of Distilled Water. Now add the Tincture of Caramel and enough Distilled Water to make 1000 mils, incorporate the Talc and filter
Solutions of Chemicals in Vehicle Elixirs		
Elixir Ammonii Bromidi	85 Gm. Ammonium Bromide; 200 mils Syrup; 460 mils Distilled Water; Aromatic Elixir, enough to make 1000 mils	Dissolve the salt in the Distilled Water, add the Syrup and enough Aromatic Elixir to make 1000 mils. Filter
Ammonii Valeratis	35 Gm. Ammonium Valerate; 1.5 mils Chloroform; 16 mils Tincture of Vanilla; 16 mils Compound Tincture of Cudbear; Ammonia Water and Aromatic Elixir, each, enough to make 1000 mils	Dissolve the Ammonium Valerate in 65 mils of Aromatic Elixir and add a slight excess of Ammonia Water to neutralize any free Valeric Acid. Then add the Chloroform and Tinctures and enough Aromatic Elixir to make 1000 mils. Filter

Elixirs of the N. F. IV—*Continued*

Title	Ingredients	Method of Preparation
Solutions of Chemicals in Vehicle Elixirs (*Continued*)		
Elixir Bismuthi	125 mils Glycerite of Bismuth; 125 mils Glycerin; 250 mils Distilled Water; Aromatic Elixir, enough to make 1000 mils	Mix the ingredients in the order given and filter
Buchu et Potassii Acetatis	85 Gm. Potassium Acetate; Elixir of Buchu, enough to make 1000 mils	Dissolve the salt in the Elixir and filter
Calcii Bromidi	85 Gm. Calcium Bromide; 4 mils Diluted Hydrobromic Acid; 200 mils Syrup; 460 mils Distilled Water; Aromatic Elixir, enough to make 1000 mils	Dissolve the salt in the Distilled Water, add the Syrup and enough Aromatic Elixir to make 1000 mils. Filter
Calcii et Sodii Glycerophosphatum	25 Gm. Solution of Sodium Glycerophosphate; 8.75 Gm. Calcium Glycerophosphate; 8 mils Phosphoric Acid; 300 mils Glycerin; 300 mils Aromatic Elixir; Distilled Water, enough to make 1000 mils	Dissolve the Glycerophosphates in the Acid mixed with 300 mils of Distilled Water. Then add the Glycerin, Aromatic Elixir and finally enough Distilled Water to make 1000 mils. Filter
Calcii Hypophosphitis	35 Gm. Calcium Hypophosphite; 4 mils Hypophosphorous Acid; Aromatic Elixir, enough to make 1000 mils	Dissolve the salt in 750 mils of Aromatic Elixir containing the Acid, then add enough Aromatic Elixir to make 1000 mils and filter
Calcii Lactophosphatis	10 Gm. Precipitated Calcium Carbonate; 30 mils Lactic Acid; 15 mils Phosphoric Acid; 10 mils Compound Spirit of Orange; 350 mils Syrup; 200 mils Alcohol; 20 Gm. Purified Talc; Distilled Water, enough to make 1000 mils	Dissolve the Calcium Carbonate in the Lactic Acid and 200 mils of Distilled Water, add the Phosphoric Acid and enough Water to make 50 mils. Then add the Syrup, the mixed Alcohol and Spirit and enough Water to make 1000 mils. Incorporate the Talc and filter
Cinchonæ Alkaloidorum	2 Gm. Quinine Sulphate; 1 Gm. Cinchonidine Sulphate; 1 Gm. Cinchonine Sulphate; 50 mils Compound Tincture of Cudbear; 20 Gm. Purified Talc; Aromatic Elixir, enough to make 1000 mils	Dissolve the alkaloids in 900 mils of Aromatic Elixir, add the Tincture and enough Aromatic Elixir to make 1000 mils. Incorporate the Talc, and filter after standing for several hours
Cinchonæ Alkaloidorum et Ferri	35 Gm. Ferric Phosphate; 60 mils Distilled Water; Elixir of Cinchona Alkaloids, enough to make 1000 mils	Dissolve the Ferric Phosphate in the Distilled Water with the aid of heat and add enough of the Elixir to make 1000 mils. Filter
Cinchonæ Alkaloidorum et Hypophosphitum	17.5 Gm. Calcium Hypophosphite; 17.5 Gm. Sodium Hypophosphite; 8 mils Hypophosphorous Acid; 125 mils Distilled Water; Elixir of Cinchona Alkaloids, enough to make 1000 mils	Dissolve the salts in the Distilled Water and Acid and add enough of the Elixir to make 1000 mils. Filter
Cinchonæ Alkaloidorum, Ferri, Bismuthi et Strychninæ	0.175 Gm. Strychnine Sulphate; 10 mils Distilled Water; Elixir of Cinchona Alkaloids, Iron and Bismuth, enough to make 1000 mils	Dissolve the Strychnine Sulphate in the Distilled Water and add enough of the Elixir to make 1000 mils. Filter
Cinchonæ Alkaloidorum, Ferri et Bismuthi	65 mils Glycerite of Bismuth; 65 mils Distilled Water; Elixir of Cinchona Alkaloids and Iron, enough to make 1000 mils	Mix the Glycerite and Distilled Water with enough of the Elixir to make 1000 mils
Cinchonæ Alkaloidorum, Ferri et Calcii Lactophosphatis	500 mils Syrup of Calcium Lactophosphate; 30 Gm. Potassium Citrate; Elixir of Cinchona Alkaloids and Iron, enough to make 1000 mils	Dissolve the Potassium Citrate in 450 mils of the Elixir, add the Syrup and enough of the Elixir to make 1000 mils
Cinchonæ Alkaloidorum, Ferri et Pepsini	200 mils Glycerite of Pepsin; Elixir of Cinchona Alkaloids and Iron, enough to make 1000 mils	Mix them and filter
Cinchonæ Alkaloidorum, Ferri et Strychninæ	0.175 Gm. Strychnine Sulphate; 10 mils Distilled Water; Elixir of Cinchona Alkaloids and Iron, enough to make 1000 mils	Dissolve the Strychnine Sulphate in the Distilled Water and add enough of the Elixir to make 1000 mils. Filter

Elixirs of the N. F. IV—*Continued*

Title	Ingredients	Method of Preparation
Solutions of Chemicals in Vehicle Elixirs (*Continued*)		
Elixir Ferri Hypophosphitis	16.5 Gm. Ferric Hypophosphite; 21.5 Gm. Potassium Citrate; 35 mils Distilled Water; Aromatic Elixir, enough to make 1000 mils	Dissolve the Ferric Hypophosphite and Potassium Citrate in the Distilled Water with the aid of heat, and then add enough Aromatic Elixir to make 1000 mils. Filter
Ferri Lactatis	17.5 Gm. Ferrous Lactate; 52.5 Gm. Potassium Citrate; 120 mils Distilled Water; Aromatic Elixir, enough to make 1000 mils	Dissolve the Ferrous Lactate and Potassium Citrate in the Distilled Water with the aid of heat, and then add enough Aromatic Elixir to make 1000 mils. Filter
Ferri Phosphatis	35 Gm. Ferric Phosphate; 60 mils Distilled Water; Aromatic Elixir, enough to make 1000 mils	Dissolve the Ferric Phosphate in the Distilled Water with the aid of heat and add enough Aromatic Elixir to make 1000 mils. Filter
Ferri Pyrophosphatis	35 Gm. Ferric Pyrophosphate; 60 mils Distilled Water; Aromatic Elixir, enough to make 1000 mils	Dissolve the Ferric Pyrophosphate in the Distilled Water with the aid of heat and add enough Aromatic Elixir to make 1000 mils. Filter
Ferri Pyrophosphatis, Quininæ et Strychninæ	35 Gm. Ferric Pyrophosphatis; 8.75 Gm. Quinine Sulphate; 0.14 Gm. Strychnine; 0.7 Gm. Citric Acid; 0.7 mil Oil of Orange; 250 mils Alcohol; 375 mils Syrup; Ammonia Water and Distilled Water, each, enough to make 1000 mils	Triturate together the Quinine Sulphate, Strychnine and Citric Acid and add the Alcohol and Oil. Then add the Syrup, heated to 65° C. (149° F.), and stir until clear. Dissolve the Ferric Pyrophosphate in 320 mils of Distilled Water; add it to the solution just made, neutralize with Ammonia Water and add enough Distilled Water to make 1000 mils
Ferri, Quininæ et Strychninæ	125 mils Tincture of Ferric Citrochloride; 8.75 Gm. Quinine Hydrochloride; 0.175 Gm. Strychnine Sulphate; 10 mils Compound Spirit of Orange; 240 mils Alcohol; 300 mils Glycerin; 20 Gm. Purified Talc; Distilled Water, enough to make 1000 mils	Dissolve the Quinine Hydrochloride in the Alcohol; add the Compound Spirit, then the Strychnine Sulphate, dissolved in 10 mils of Distilled Water, the Glycerin, the Tincture and enough Distilled Water to make 1000 mils. Finally incorporate the Talc and filter
Formatum	41 Gm. Potassium Carbonate; 36 Gm. Monohydrated Sodium Carbonate; 225 mils Formic Acid; Aromatic Elixir, enough to make 1000 mils	Dissolve the salts in the Formic Acid and add enough Aromatic Elixir to make 1000 mils
Formatum Compositum	23 Gm. Monohydrated Sodium Carbonate; 20 Gm. Magnesium Carbonate; 25 Gm. Strontium Carbonate; 8 Gm. Lithium Carbonate; 7.7 Gm. Quinine; 200 mils Formic Acid; 5 mils Compound Spirit of Cardamom, 2 mils Acetic Ether; 100 mils Alcohol; 300 mils Glycerin; 20 Gm. Purified Talc; Distilled Water, enough to make 1000 mils	Dissolve the Carbonates and then the Quinine in the Acid, mixed with 300 mils of Distilled Water. To this add the Glycerin and the Alcohol, previously mixed with the Compound Spirit and Acetic Ether. Mix thoroughly, add enough Water to make 1000 mils, incorporate the Talc and filter
Gentianæ et Ferri	100 mils Tincture of Ferric Citrochloride; Elixir of Gentian, enough to make 1000 mils	Mix and filter
Gentianæ et Ferri Phosphatis	17.5 Gm. Ferric Phosphate; 35 mils Distilled Water; Elixir of Gentian, enough to make 1000 mils	Dissolve the Ferric Phosphate in the Water with the aid of heat and add enough of the Elixir to make 1000 mils
Glycerophosphatum Compositum	40 Gm. Solution of Sodium Glycerophosphate; 16 Gm. Calcium Glycerophosphate; 3 Gm. Ferric Glycerophosphate; 2 Gm. Soluble Manganese Glycerophosphate; 1 Gm. Quinine Glycerophosphate; 0.15 Gm. Strychnine Glycerophosphate; 10 mils Lactic Acid; 2 mils Compound Spirit of Cardamom; 125 mils Alcohol; 350 mils Glycerin; 20 Gm. Purified Talc; Distilled Water, enough to make 1000 mils	Triturate the Calcium Glycerophosphate with 100 mils of Glycerin; dissolve the Ferric and Manganese salts in 30 mils of Distilled Water, containing 4 mils of Lactic Acid, and using heat. Now dissolve the Strychnine and Quinine Salts in 100 mils of Distilled Water, containing the remaining Lactic Acid, and the Sodium Glycerophosphate in 30 mils of hot Distilled Water, and add all solutions to the Calcium Glycerophosphate mixture. Mix thoroughly, add the remaining Glycerin, the Alcohol, the Compound Spirit and enough Distilled Water to make 1000 mils. Finally incorporate the Talc and filter

Elixirs of the N. F. IV—*Continued*

Title	Ingredients	Method of Preparation
Solutions of Chemicals in Vehicle Elixirs (*Continued*)		
Elixir Hypophosphitum	52.5 Gm. Calcium Hypophosphite; 17.5 Gm. Sodium Hypophosphite; 17.5 Gm. Potassium Hypophosphite; 4 mils Hypophosphorous Acid; 420 mils Distilled Water; 30 mils Glycerin; 0.6 mil Compound Spirit of Cardamom; Aromatic Elixir, enough to make 1000 mils	Dissolve the Hypophosphites in the Distilled Water to which the Acid has been added, then add the Glycerin, the Compound Spirit, and enough Aromatic Elixir to make 1000 mils
Hypophosphitum et Ferri	17.5 Gm. Calcium Hypophosphite; 17.5 Gm. Sodium Hypophosphite; 8.75 Gm. Potassium Hypophosphite; 8.75 Gm. Ferric Hypophosphite; 11 Gm. Potassium Citrate; 4 mils Hypophosphorous Acid; 250 mils Distilled Water; 250 mils Syrup; Aromatic Elixir, enough to make 1000 mils	Dissolve the Ferric Hypophosphite and Potassium Citrate in 50 mils of warm Distilled Water and add the Syrup. Dissolve the other Hypophosphites in the remainder of the Distilled Water and mix the two solutions. Finally add the Acid, and enough Aromatic Elixir to make 1000 mils and filter
Lithii Bromidi	85 Gm. Lithium Bromide; 200 mils Syrup; 460 mils Distilled Water; Aromatic Elixir, enough to make 1000 mils	Dissolve the salt in the Distilled Water, add the Syrup and enough Aromatic Elixir to make 1000 mils and filter
Lithii Citratis	85 Gm. Lithium Citrate; Aromatic Elixir, enough to make 1000 mils	Dissolve the salt in enough Aromatic Elixir to make 1000 mils and filter
Lithii Salicylatis	85 Gm. Lithium Salicylate; Aromatic Elixir, enough to make 1000 mils	Dissolve the Salt in enough Aromatic Elixir to make 1000 mils and filter
Phosphori	0.25 Gm. Phosphorus; 5 mils Chloroform; 340 mils Alcohol; 300 mils Glycerin; 10 mils Compound Spirit of Orange; 2 mils Oil of Anise; 30 Gm. Purified Talc; Distilled Water, enough to make 1000 mils	Weigh the Phosphorus under Water and dissolve it in the Chloroform in a flask, on a water bath, using enough heat to melt the Phosphorus. Add the Chloroform Solution to the Alcohol, heated to about 60° C. (140° F.), and contained in a bottle graduated to 1000 mils. Now add the Oil, the Compound Spirit, and the Glycerin, in divided portions, and then enough Distilled Water to make 1000 mils. Finally incorporate the Talc and filter
Phosphori et Nucis Vomicæ	3.5 mils Tincture of Nux Vomica; Elixir of Phosphorus, enough to make 100 mils	Mix them
Potassii Acetatis	85 Gm. Potassium Acetate; Aromatic Elixir, enough to make 1000 mils	Dissolve the salt in enough Aromatic Elixir to make 1000 mils and filter
Potassii Acetatis et Juniperi	85 Gm. Potassium Acetate; 125 mils Fluidextract of Juniper; 20 Gm. Purified Talc; Aromatic Elixir, enough to make 1000 mils	Mix the Fluidextract with 750 mils of the Elixir in which the Potassium Acetate has been dissolved and then add enough Aromatic Elixir to make 1000 mils. Incorporate the Talc and filter after 12 hours
Potassii Bromidi	175 Gm. Potassium Bromide; 200 mils Syrup; 460 mils Distilled Water; Aromatic Elixir, enough to make 1000 mils	Dissolve the salt in the Distilled Water, add the Syrup and enough Aromatic Elixir to make 1000 mils and filter
Quininæ Valeratis et Strychninæ	17.5 Gm. Quinine Valerate; 0.175 Gm. Strychnine Sulphate; 15 mils Compound Tincture of Cudbear; 5 mils Distilled Water; Aromatic Elixir, enough to make 1000 mils	Dissolve the Strychnine Sulphate in the Distilled Water; add to 800 mils of Aromatic Elixir and dissolve the Quinine Valerate in the liquid. Then add the Compound Tincture and enough Aromatic Elixir to make 1000 mils and filter
Sodii Bromidi	175 Gm. Sodium Bromide; 200 mils Syrup; 460 mils Distilled Water, Aromatic Elixir, enough to make 1000 mils	Dissolve the salt in the Distilled Water, add the Syrup and enough Aromatic Elixir to make 1000 mils and filter
Sodii Hypophosphitis	35 Gm. Sodium Hypophosphite; 4 mils Hypophosphorous Acid; Aromatic Elixir, enough to make 1000 mils	Dissolve the salt in 825 mils of Aromatic Elixir, add the Acid and enough Aromatic Elixir to make 1000 mils and filter
Sodii Salicylatis	85 Gm. Sodium Salicylate; 200 mils Syrup; 460 mils Distilled Water; Aromatic Elixir, enough to make 1000 mils	Dissolve the salt in the Distilled Water, add the Syrup and enough Aromatic Elixir to make 1000 mils and filter

Elixirs of the N. F. IV—*Continued*

Title	Ingredients	Method of Preparation
Solutions of Chemicals in Vehicle Elixirs (*Continued*)		
Elixir Sodii Salicylatis Compositum	80 Gm. Sodium Salicylate; 32 mils Fluidextract of Cimicifuga; 16 mils Fluidextract of Gelsemium; 15 Gm. Potassium Iodide; 20 Gm. Purified Talc; Aromatic Elixir, enough to make 1000 mils	Dissolve the salts in 800 mils of Aromatic Elixir, add the Fluidextracts and enough of the Elixir to make 1000 mils. Finally incorporate the Talc and filter
Strychninæ Valeratis	0.175 Gm. Strychnine Valerate; 5 mils Distilled Water; 15 mils Tincture of Vanilla; 15 mils Compound Tincture of Cudbear; Aromatic Elixir, enough to make 1000 mils	Dissolve the Strychnine Valerate in the Distilled Water with the aid of heat, add 900 mils of Aromatic Elixir, then the Tinctures and enough Aromatic Elixir to make 1000 mils and filter
Terpini Hydratis	17.5 Gm. Terpin Hydrate; 20 mils Tincture of Sweet Orange Peel; 5 mils Spirit of Bitter Almond; 425 mils Alcohol; 400 mils Glycerin; 100 mils Syrup; Distilled Water, enough to make 1000 mils	Dissolve the Terpin Hydrate in the Alcohol, then add the Tincture, Spirit, Glycerin, Syrup and enough Aromatic Elixir to make 1000 mils and filter
Terpini Hydratis et Codeinæ	2 Gm. Codeine; Elixir of Terpin Hydrate, enough to make 1000 mils	Dissolve the Codeine in enough of the Elixir to make 1000 mils and filter
Terpini Hydratis et Diacetylmorphinæ	0.27 Gm. Diacetylmorphine Hydrochloride; Elixir of Terpin Hydrate, enough to make 1000 mils	Dissolve the salt in enough of the Elixir to make 1000 mils and filter
Trium Bromidorum	80 Gm. Ammonium Bromide; 80 Gm. Potassium Bromide; 80 Gm. Sodium Bromide; 2 Gm. Cudbear; Compound Elixir of Almond, enough to make 1000 mils	Dissolve the Bromides in 800 mils of the Compound Elixir, introduce the Cudbear, macerate for 6 hours, add enough of the Compound Elixir to make 1000 mils and filter
Zinci Valeratis	17.5 Gm. Zinc Valerate; 56 Gm. Citric Acid; 125 mils Alcohol; 10 mils Spirit of Bitter Almond; 15 mils Compound Tincture of Cudbear; Stronger Ammonia Water, Distilled Water, and Aromatic Elixir, each, enough to make 1000 mils	Neutralize the Citric Acid with the Stronger Ammonia Water and add enough Distilled Water to make 100 mils. Add 250 mils of Aromatic Elixir and the Alcohol, and dissolve the Zinc Valerate in the mixture. Then add the Spirit and Compound Tincture and enough Aromatic Elixir to make 1000 mils and filter
From Fluidextracts or Drugs		
Elixir Buchu	125 mils Fluidextract of Buchu; 50 mils Alcohol; 20 Gm. Purified Talc; Aromatic Elixir, enough to make 1000 mils	Mix the Fluidextract with the Alcohol, then add enough Aromatic Elixir to make 1000 mils, incorporate the Talc and filter after 12 hours
Buchu Compositum	250 mils Compound Fluidextract of Buchu; 20 Gm. Purified Talc; Aromatic Elixir, enough to make 1000 mils	Mix the Compound Fluidextract with enough Aromatic Elixir to make 1000 mils, incorporate the Talc and filter after 12 hours
Cascaræ Sagradæ	500 mils Aromatic Fluidextract of Cascara Sagrada; 500 mils Aromatic Elixir	Mix them and filter after 12 hours
Cascaræ Sagradæ Compositum	125 mils Aromatic Fluidextract of Cascara Sagrada; 75 mils Fluidextract of Senna; 65 mils Fluidextract of Juglans; Aromatic Elixir, enough to make 1000 mils	Mix them and filter after 12 hours
Catharticum Compositum	125 mils Fluidextract of Frangula; 100 mils Fluidextract of Senna; 62 mils Fluidextract of Rhubarb; 14 mils Spirit of Peppermint; 4.5 mils Solution of Potassium Hydroxide; Aromatic Elixir, enough to make 1000 mils	Mix the Solution of Potassium Hydroxide with 600 mils of Aromatic Elixir, add the Fluidextracts and Spirit and enough Aromatic Elixir to make 1000 mils. Filter after standing 24 hours
Corydalis Compositum	60 mils Fluidextract of Corydalis; 60 mils Fluidextract of Stillingia; 30 mils Fluidextract of Xanthoxylum; 90 mils Fluidextract of Blue Flag; 125 mils Alcohol; 50 Gm. Potassium Iodide; Aromatic Elixir, enough to make 1000 mils	Mix the Fluidextracts, add the Alcohol, dissolve the Potassium Iodide in the mixture, add enough Aromatic Elixir to make 1000 mils and filter

Elixirs of the N. F. IV—*Continued*

Title	Ingredients	Method of Preparation
From Fluidextracts or Drugs *(Continued)*		
Elixir Gentianæ	35 mils Fluidextract of Gentian; 15 mils Compound Spirit of Cardamom; 30 Gm. Sodium Citrate; 50 mils Glycerin; 250 mils Syrup; 200 mils Alcohol; 20 Gm. Purified Talc; Distilled Water, enough to make 1000 mils	Dissolve the Sodium Citrate in 350 mils of Distilled Water, mix this solution with the Alcohol and Compound Spirit, then add the Fluidextract of Gentian, the Syrup, the Glycerin, and enough Distilled Water to make 1000 mils. Finally incorporate the Talc and filter
Gentianæ Glycerinatum	10 mils Fluidextract of Gentian; 15 mils Fluidextract of Taraxacum; 0.5 mil Acetic Ether; 5 mils Phosphoric Acid; 15 mils Tincture of Sweet Orange Peel; 60 mils Compound Tincture of Cardamom; 400 mils Glycerin; 200 Gm. Sugar; Sherry Wine, enough to make 1000 mils	Dissolve the Sugar in 325 mils of the Wine; add the other ingredients previously mixed, and enough Wine to make 1000 mils. Filter after standing 24 hours
Guaranæ	200 mils Fluidextract of Guarana; 200 mils Aromatic Elixir; Compound Elixir of Taraxacum, enough to make 1000 mils	Mix them and filter after standing 12 hours
Humuli	125 mils Fluidextract of Hops; 30 mils Tincture of Vanilla; 125 mils Compound Elixir of Taraxacum; 20 Gm. Purified Talc; Aromatic Elixir, enough to make 1000 mils	Incorporate the Talc with the Fluidextract, then gradually add the Compound Elixir of Taraxacum, the Tincture, and enough Aromatic Elixir to make 1000 mils. Filter after standing 12 hours
Rubi Compositum	16 Gm. Rubus; 16 Gm. Nutgall; 16 Gm. Saigon Cinnamon; 4 Gm. Clove; 2 Gm. Mace; 2 Gm. Jamaica Ginger; 750 mils Syrup of Blackberry Fruit; Diluted Alcohol, enough to make 1000 mils	Percolate the mixed drugs with Diluted Alcohol until the percolate measures 250 mils. Add the Syrup to the percolate and filter after standing several days
Viburni Opuli Compositum	75 mils Fluidextract of Viburnum Opulus; 150 mils Fluidextract of Trillium; 75 mils Fluidextract of Aletris; Compound Elixir of Taraxacum, enough to make 1000 mils	Mix the Fluidextracts with the Elixir and filter after standing 12 hours
Viburni Prunifolii	125 mils Fluidextract of Viburnum Prunifolium; 75 mils Compound Tincture of Cardamom; Aromatic Elixir, enough to make 1000 mils	Mix them and filter after standing 12 hours
Elixirs Containing Pepsin		
Elixir Pepsini	200 mils Glycerite of Pepsin; 100 mils Glycerin; 4 mils Hydrochloric Acid; Aromatic Elixir, enough to make 1000 mils	Mix the Glycerite, Glycerin, and Hydrochloric Acid and add enough Aromatic Elixir to make 1000 mils
Pepsini, Bismuthi, et Strychninæ	0.175 Gm. Strychnine; 0.175 Gm. Tartaric Acid; Elixir of Pepsin and Bismuth, enough to make 1000 mils	Dissolve the Strychnine and Tartaric Acid in 30 mils of the Elixir by trituration and add enough Aromatic Elixir to make 1000 mils
Pepsini et Bismuthi	8.5 Gm. Pepsin; 125 mils Glycerin; 125 mils Glycerite of Bismuth; 250 mils Distilled Water; 5 mils Tincture of Caramel; Aromatic Elixir, enough to make 1000 mils	Dissolve the Pepsin in the Glycerin and Distilled Water; add the Glycerite of Bismuth and 490 mils of Aromatic Elixir and nearly neutralize the mixture with Solution of Sodium Hydroxide. Then add the Tincture of Caramel, and enough Aromatic Elixir to make 1000 mils and filter
Pepsini et Ferri	75 mils Tincture of Ferric Citrochloride; Elixir of Pepsin, enough to make 1000 mils	Mix and filter
Pepsini et Rennini Compositum	22.5 Gm. Pepsin; 16.5 Gm. Rennin; 2 mils Lactic Acid; 15 mils Tincture of Sweet Orange Peel; 150 mils Glycerin; 200 mils Alcohol; 0.1 mil Oil of Myristica; 20 Gm. Purified Talc; Distilled Water, enough to make 1000 mils	Mix the Pepsin and Rennin with 300 mils of Distilled Water; add the Lactic Acid and Glycerin, and when solution has resulted on standing, with occasional gentle agitation, add the mixed Tincture, Oil and Alcohol, in portions, and enough Distilled Water to make 1000 mils. Finally incorporate the Talc and filter after standing 24 hours

Unofficial Elixir

Title	Ingredients	Method of Preparation
Elixir Ferri, Quininæ et Strychninæ Phosphatum, U. S. P. VIII	17.5 Gm. Soluble Ferric Phosphate; 8.75 Gm. Quinine; 0.275 Gm. Strychnine; 2 mils Phosphoric Acid; 9 Gm. Ammonium Carbonate; 60 mils Alcohol; 28.65 Gm. Acetic Acid; Ammonia Water, Distilled Water, and Aromatic Elixir, each, enough to make 1000 mils	Dissolve the Quinine and Strychnine in the Alcohol, add the Phosphoric Acid and 350 mils of Aromatic Elixir. Dissolve the Ammonium Carbonate in the Acetic Acid, neutralize with Ammonia Water, and add enough Water to make 50 mils, mix the two solutions just prepared and add enough Aromatic Elixir to make 850 mils. Dissolve the Ferric Phosphate in 30 mils of Water with a gentle heat, neutralize to litmus with Ammonia Water and add enough Aromatic Elixir to make 150 mils. Finally mix the two solutions and filter

ELIXIR AROMATICUM. U. S. Aromatic Elixir

[Elix. Arom. Simple Elixir]

	Metric	Old form
*Compound Spirit of Orange	12 mils	184 min.
Syrup	375 mils	12 fl. oz.
Purified Talc	30 Gm.	1 oz. av.
Alcohol,		
Distilled Water, each, a sufficient quantity,		
To make	1000 mils	2 pints

To the compound spirit of orange, add enough alcohol to make 250 mils [old form 8 fl. oz.]. To this solution, add the syrup in several portions, agitating after each addition, and afterwards add, in the same manner, 375 mils [old form 12 fl. oz.] of distilled water. Mix the purified talc intimately with the liquid, and then filter through a wetted filter, returning the first portions of the filtrate until a transparent liquid is obtained. Lastly, wash the filter with a mixture of one volume of alcohol and three volumes of distilled water, until the product measures 1000 mils [old form 2 pints].

The purified talc in this formula may be advantageously replaced by purified siliceous earth which insures more rapid filtration.

U. S. P. Preparations.—Elixir Glycyrrhizæ; Liquor Ferri et Ammonii Acetatis.

N. F. Preparations.—Elixir Aromaticum Rubrum; also in many medicated elixirs; Liquor Ferri Albuminati; Liquor Ferri Peptonati; Liquor Ferri Peptonati et Mangani.

ELIXIR GLYCYRRHIZÆ. U. S. Elixir of Glycyrrhiza

[Elix. Glycyrrh. Elixir Adjuvans, U. S. P. VIII Elixir of Licorice]

	Metric	Old form
*Fluidextract of Glycyrrhiza	125 mils	4 fl. oz.
Aromatic Elixir	875 mils	28 fl. oz.
To make	1000 mils	2 pints

Mix and filter.

ELIXIR AMMONII BROMIDI. N. F. Elixir of Ammonium Bromide

[Elix. Ammon. Brom.]

	Metric	Old form
Ammonium Bromide	85 Gm.	2 oz. av. 366 gr.
Syrup	200 mils	6 fl. oz. 192 min.
Distilled Water	460 mils	14 fl. oz. 346 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the ammonium bromide in the distilled water, add the syrup and sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

It will be observed that all elixirs containing bromides are made with only a small percentage of aromatic elixir, water serving as the main solvent. This is for the purpose of reducing the alcohol content which, if present in large amount, would interfere with the action of the bromide.

Average dose.—1 fluidrachm (4 mils).

ELIXIR AMMONII VALERATIS. N. F. Elixir of Ammonium Valerate

[Elix. Ammon. Valer. Elixir Ammonii Valerianatis, N. F. III]

	Metric	Old form
Ammonium Valerate	**35.0 Gm.**	1 oz. av. 74 gr.
Chloroform	**1.5 mils**	23 min.
Tincture of Vanilla	**16.0 mils**	246 min.
Compound Tincture of Cudbear	**16.0 mils**	246 min.
Ammonia Water,		
Aromatic Elixir, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the ammonium valerate in about 65 mils [old form 2 fl. oz. 38 minims] of aromatic elixir and add ammonia water, in drops, until a faint excess of it is perceptible in the liquid, using litmus paper as an indicator. Then add the chloroform, tincture of vanilla and compound tincture of cudbear, and enough aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

If the ammonia is not in excess, free valeric acid is present and renders the preparation offensive in odor and taste.

Average dose.—1 fluidrachm (4 mils).

ELIXIR AMYGDALÆ COMPOSITUM. N. F. Compound Elixir of Almond

[Elix. Amygdal. Co.]

	Metric	Old form
Oil of Bitter Almond	**0.5 mil**	8 min.
Vanillin	**1.0 Gm.**	15 gr.
Stronger Orange Flower Water	**150.0 mils**	4 fl. oz. 384 min.
Alcohol	**50.0 mils**	1 fl. oz. 288 min.
Syrup	**400.0 mils**	12 fl. oz. 384 min.
Purified Talc	**20.0 Gm.**	292 gr.
Distilled Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the oil of bitter almond and the vanillin in the alcohol, add the syrup, the stronger orange flower water and then sufficient distilled water, in several portions, shaking the mixture thoroughly after each addition, to make the product measure 1000 mils [old form 2 pints]. Finally incorporate the purified talc and filter the mixture, returning the first portions of the filtrate until it passes through clear.

This elixir offers the physician a pleasantly flavored vehicle of low alcoholic strength.

N. F. Preparation.—Elixir Trium Bromidorum.

ELIXIR ANISI. N. F. Elixir of Anise
[Elix. Anis.]

	Metric	Old form
Anethol	3.5 mils	54 min.
Oil of Fennel	0.5 mil	8 min.
Spirit of Bitter Almond	12.0 mils	184 min.
Alcohol	240.0 mils	7 fl. oz. 326 min.
Syrup	625.0 mils	20 fl. oz.
Purified Talc	20.0 Gm.	292 gr.
Distilled Water, a sufficient quantity,		
To make about	1000 mils	2 pints

Mix the anethol, oil, and spirit of bitter almond with the alcohol, add the syrup and sufficient distilled water to make the product measure 1000 m ls [old form 2 pints]. Add the purified talc and set the mixture aside for twelve hours. Then cool it to about 15° C. (59° F.) and filter, returning the first portions of the filtrate until it runs through clear.

Average dose.—For infants, 15 minims (1 mil).

ELIXIR AROMATICUM RUBRUM. N. F. Red Aromatic Elixir
[Elix. Arom. Rub. Red Elixir]

	Metric	Old form
Cudbear	2 Gm.	29 gr.
Aromatic Elixir	1000 mils	2 pints
To make	1000 mils	2 pints

Add the cudbear to the aromatic elixir, in a suitable container, allow the mixture to stand for six hours with occasional agitation and then filter. This preparation offers the physician a red colored vehicle.

ELIXIR AURANTII AMARI. N. F. Elixir of Bitter Orange
[Elix. Aurant. Amar.]
(To replace Elixir Curassao, N. F. III)

	Metric	Old form
Oil of Bitter Orange	4 mils	1 fl. dr.
Tincture of Bitter Orange Peel	20 mils	307 min.
Alcohol	300 mils	9 fl. oz. 288 min.
Stronger Orange Flower Water	20 mils	307 min.
Syrup	400 mils	12 fl. oz. 384 min.
Purified Talc	20 Gm.	292 gr.
Distilled Water, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the oil of bitter orange and the tincture of bitter orange peel with the alcohol, add the syrup, the stronger orange flower water and then sufficient distilled water, in several portions, shaking the mixture after each addition, to make the product measure 1000 mils [old form 2 pints]. Finally incorporate the purified talc and filter the mixture, returning the first portions of the filtrate until it passes through clear. It is used as pleasantly flavored vehicle.

ELIXIR BISMUTHI. N. F. Elixir of Bismuth
[Elix. Bismuth.]

	Metric	Old form
Glycerite of Bismuth	125 mils	4 fl. oz.
Glycerin	125 mils	4 fl. oz.
Distilled Water	250 mils	8 fl. oz.
Aromatic Elixir, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the ingredients in the order given and filter the product.

Average dose.—1 fluidrachm (4 mils).

ELIXIR BUCHU. N. F. Elixir of Buchu
[Elix. Buchu]

	Metric	Old form
Fluidextract of Buchu	125 mils	4 fl. oz.
Alcohol	50 mils	1 fl. oz. 288 min.
Purified Talc	20 Gm.	292 gr.
Aromatic Elixir, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the fluidextract of buchu with the alcohol and then add sufficient aromatic elixir to make 1000 mils [old form 2 pints] and add the purified talc. Shake the mixture occasionally during twelve hours and then filter, returning the first portions of the filtrate until it passes through clear.

N. F. Preparation.—Elixir Buchu et Potassii Acetatis.

Average dose.—1 fluidrachm (4 mils).

ELIXIR BUCHU COMPOSITUM. N. F. Compound Elixir of Buchu
[Elix. Buchu Co.]

	Metric	Old form
Compound Fluidextract of Buchu	250 mils	8 fl. oz.
Purified Talc	20 Gm.	292 gr.
Aromatic Elixir, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the compound fluidextract of buchu with sufficient aromatic elixir to make 1000 mils [old form 2 pints], add the purified talc and mix thoroughly. Shake the mixture occasionally during twelve hours and filter, returning the first portions of the filtrate until it passes through clear.

Average dose.—1 fluidrachm (4 mils).

ELIXIR BUCHU ET POTASSII ACETATIS. N. F. Elixir of Buchu and Potassium Acetate
[Elix. Buchu et Pot. Acet.]

	Metric	Old form
Potassium Acetate	85 Gm.	2 oz. av. 366 gr.
Elixir of Buchu, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the potassium acetate in sufficient elixir of buchu to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR CALCII BROMIDI. N. F. Elixir of Calcium Bromide
[Elix. Calc. Brom.]

	Metric	Old form
Calcium Bromide	85 Gm.	2 oz. av. 366 gr.
Diluted Hydrobromic Acid	4 mils	1 fl. dr.
Syrup	200 mils	6 fl. oz. 192 min.
Distilled Water	460 mils	14 fl. oz. 346 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the calcium bromide in the distilled water, to which has been added the diluted hydrobromic acid, add the syrup and sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR CALCII ET SODII GLYCEROPHOSPHATUM. N. F. Elixir of Calcium and Sodium Glycerophosphates

[Elix. Calc. et Sod. Glycerophos. ELIXIR GLYCEROPHOSPHATUM, N. F. III]

	Metric	Old form
Solution of Sodium Glycerophosphate	**25.00 Gm.**	365 gr.
Calcium Glycerophosphate	**8.75 Gm.**	128 gr.
Phosphoric Acid	**8.00 mils**	2 fl. dr.
Glycerin	**300.00 mils**	9 fl. oz. 288 min.
Aromatic Elixir	**300.00 mils**	9 fl. oz. 288 min.
Distilled Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the glycerophosphates in the acid and 300 mils [old form 9 fl. oz. 288 minims] of distilled water, add the glycerin and aromatic elixir, and finally enough distilled water to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR CALCII HYPOPHOSPHITIS. N. F. Elixir of Calcium Hypophosphite

[Elix. Calc. Hypophos.]

	Metric	Old form
Calcium Hypophosphite	**35 Gm.**	1 oz. av. 74 gr.
Hypophosphorous Acid	**4 mils**	1 fl. dr.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the calcium hypophosphite in 750 mils [old form 24 fl. oz.] of aromatic elixir to which has been added the hypophosphorus acid; then add sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—2 fluidrachms (8 mils).

ELIXIR CALCII LACTOPHOSPHATIS. N. F. Elixir of Calcium Lactophosphate

[Elix. Calc. Lactophos.]

	Metric	Old form
Precipitated Calcium Carbonate	**10 Gm.**	146 gr.
Lactic Acid	**30 mils**	461 min.
Phosphoric Acid	**15 mils**	230 min.
Compound Spirit of Orange	**10 mils**	2½ fl. dr.
Syrup	**350 mils**	11 fl. oz. 96 min.
Alcohol	**200 mils**	6 fl. oz. 192 min.
Purified Talc	**20 Gm.**	292 gr.
Distilled Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the precipitated calcium carbonate in the lactic acid, which has been previously mixed with 200 mils [old form 6 fl. oz. 192 minims] of disti led water, and then add the phosphoric acid, diluted with 50 mils [old form 1 fl. oz. 288 minims] of distilled water. To this solution add the syrup and then, in divided portions, the mixture of alcohol and compound spirit of orange. Now add sufficient distilled water to make the product measure 1000 mils [old form 2 pints], then add the purified talc and filter, returning the first portions of the filtrate until it passes through clear.

Average dose.—2 fluidrachms (8 mils).

ELIXIR CARDAMOMI COMPOSITUM. N. F. **Compound Elixir of Cardamom**

[Elix. Card. Co.]

	Metric	Old form
Compound Spirit of Cardamom	**10 mils**	2½ fl. dr.
Alcohol	**90 mils**	2 fl. oz. 7 fl. dr.
Syrup	**400 mils**	12 fl. oz. 384 min.
Purified Talc	**20 Gm.**	292 gr.
Distilled Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the compound spirit of cardamom with the alcohol, add the syrup and then sufficient distilled water, in several portions, shaking the mixture thoroughly after each addition, to make the product measure 1000 mils [old form 2 pints]. Then add the purified talc and filter, returning the first portions of the filtrate until it passes through clear.

This preparation was introduced as an elixir of pleasant flavor, but of low alcoholic content.

ELIXIR CASCARÆ SAGRADÆ. N. F. **Elixir of Cascara Sagrada**

[Elix. Casc. Sagr. ELIXIR RHAMNI PURSHIANÆ, N. F. III]

	Metric	Old form
Aromatic Fluidextract of Cascara Sagrada	**500 mils**	1 pint
Aromatic Elixir	**500 mils**	1 pint
To make	**1000 mils**	2 pints

Mix them, allow the mixture to stand over night and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR CASCARÆ SAGRADÆ COMPOSITUM. N. F. **Compound Elixir of Cascara Sagrada**

[Elix. Casc. Sagr. Co. ELIXIR RHAMNI PURSHIANÆ COMPOSITUM N. F. III LAXATIVE ELIXIR]

	Metric	Old form
Aromatic Fluidextract of Cascara Sagrada	**125 mils**	4 fl. oz.
Fluidextract of Senna	**75 mils**	2 fl. oz. 192 min.
Fluidextract of Juglans	**65 mils**	2 fl. oz. 38 min.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix them, allow the mixture to stand over night and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR CATHARTICUM COMPOSITUM. N. F. **Compound Cathartic Elixir**

[Elix. Cathart. Co.]

	Metric	Old form
Fluidextract of Frangula	**125.0 mils**	4 fl. oz.
Fluidextract of Senna	**100.0 mils**	3 fl. oz. 96 min.
Fluidextract of Rhubarb	**62.0 mils**	1 fl. oz. 472 min.
Spirit of Peppermint	**14.0 mils**	215 min.
Solution of Potassium Hydroxide	**4.5 mils**	69 min.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix 600 mils [old form 19 fl. oz. 96 minims] of aromatic elixir with the solution of potassium hydroxide; then add the fluidextracts, the spirit of peppermint, and sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints]. Allow the mixture to stand twenty-four hours, and filter.

Average dose. { Aperient, 1 fluidrachm (4 mils).
Cathartic, 3 fluidrachms (12 mils).

ELIXIR CINCHONÆ ALKALOIDORUM. N. F. **Elixir of Cinchona Alkaloids**

[Elix. Cinchon. Alk. Elixir Cinchonæ, N. F. III Elixir Calisaya, Alkaloidal]

	Metric	Old form
Quinine Sulphate	**2 Gm.**	29 gr.
Cinchonidine Sulphate	**1 Gm.**	15 gr.
Cinchonine Sulphate	**1 Gm.**	15 gr.
Compound Tincture of Cudbear	**50 mils**	1 fl. oz. 288 min.
Purified Talc	**20 Gm.**	292 gr.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the alkaloidal salts in 900 mils [old form 28 fl. oz. 384 min.] of aromatic elixir; add the compound tincture of cudbear and sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints]. Then add the purified talc and mix well. Allow the mixture to stand several hours, with occasional shaking, and then filter, returning the first portions of the filtrate until it passes through clear.

This elixir replaces the former elixir of cinchona or calisaya which was made directly from the bark. This formula is preferable because tannin is absent and this permits its admixture with iron preparations without darkening.

Average dose.—2 fluidrachms (8 mils).

ELIXIR CINCHONÆ ALKALOIDORUM ET FERRI. N. F. **Elixir of Cinchona Alkaloids and Iron**

[Elix. Cinchon. et Ferr. Elixir Cinchonæ et Ferri, N. F. III Ferrated Elixir of Calisaya, Alkaloidal]

	Metric	Old form
Ferric Phosphate	**35 Gm.**	1 oz. av. 74 gr.
Distilled Water	**60 mils**	1 fl. oz. 442 min.
Elixir of Cinchona Alkaloids, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the ferric phosphate in the distilled water with the aid of heat, and add a sufficient quantity of the elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—2 fluidrachms (8 mils).

ELIXIR CINCHONÆ ALKALOIDORUM ET HYPOPHOSPHITUM. N. F.
Elixir of Cinchona Alkaloids and Hypophosphites

[Elix. Cinchon. et Hypophos. ELIXIR CINCHONÆ ET HYPOPHOSPHITUM, N. F. III ELIXIR OF CALISAYA, ALKALOIDAL, WITH HYPOPHOSPHITES]

	Metric	Old form
Calcium Hypophosphite	**17.5 Gm.**	255 gr.
Sodium Hypophosphite	**17.5 Gm.**	255 gr.
Hypophosphorous Acid	**8.0 mils**	2 fl. dr.
Distilled Water	**125.0 mils**	4 fl. oz.
Elixir of Cinchona Alkaloids, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the hypophosphites in the distilled water, to which has been added the hypophosphorous acid, then add sufficient of the elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—2 fluidrachms (8 mils).

ELIXIR CINCHONÆ ALKALOIDORUM, FERRI, BISMUTHI ET STRYCHNINÆ. N. F. Elixir of Cinchona Alkaloids, Iron, Bismuth and Strychnine

[Elix. Cinchon. Ferr. Bism. et Strych. ELIXIR CINCHONÆ, FERRI, BISMUTHI ET STRYCHNINÆ, N. F. III ELIXIR OF CALISAYA, ALKALOIDAL, WITH IRON, BISMUTH AND STRYCHNINE]

	Metric	Old form
Strychnine Sulphate	**0.175 Gm.**	2.5 gr.
Distilled Water	**10.000 mils**	2½ fl. dr.
Elixir of Cinchona Alkaloids, Iron and Bismuth, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the strychnine sulphate in the distilled water, add sufficient of the elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR CINCHONÆ ALKALOIDORUM, FERRI ET BISMUTHI. N. F.
Elixir of Cinchona Alkaloids, Iron and Bismuth

[Elix. Cinchon. Ferr. et Bism. ELIXIR CINCHONÆ, FERRI ET BISMUTHI, N. F. III ELIXIR OF CALISAYA, ALKALOIDAL, WITH IRON AND BISMUTH]

	Metric	Old form
Glycerite of Bismuth	**65 mils**	2 fl. oz. 38 min.
Distilled Water	**65 mils**	2 fl. oz. 38 min.
Elixir of Cinchona Alkaloids and Iron, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dilute the glycerite with the distilled water, add sufficient of the elixir to make the product measure 1000 mils [old form 2 pints], mix thoroughly and filter.

Average dose.—2 fluidrachms (8 mils).

ELIXIR CINCHONÆ ALKALOIDORUM, FERRI ET CALCII LACTOPHOSPHATIS. N. F. Elixir of Cinchona Alkaloids, Iron and Calcium Lactophosphate

[Elix. Cinchon. Ferr. et Calc. Lactophos. Elixir Cinchonæ, Ferri et Calcii Lactophosphatis, N. F. III Elixir of Calisaya, Iron and Lactophosphate of Lime]

	Metric	Old form
Syrup of Calcium Lactophosphate	**500 mils**	**1 pint**
Potassium Citrate	**30 Gm.**	**1 oz. av.**
Elixir of Cinchona Alkaloids and Iron, a sufficient quantity,		
To make	**1000 mils**	**2 pints**

Dissolve the potassium citrate in 450 mils [old form 14 fl. oz. 192 minims] of elixir of cinchona alkaloids and iron, add the syrup and finally enough of the elixir to make the product measure 1000 mils [old form 2 pints].

Average dose.—2 fluidrachms (8 mils).

ELIXIR CINCHONÆ ALKALOIDORUM, FERRI ET PEPSINI. N. F. Elixir of Cinchona Alkaloids, Iron and Pepsin

[Elix. Cinchon. Ferr. et Pepsin. Elixir Cinchonæ, Ferri et Pepsini, N. F. III Elixir of Calisaya, Alkaloidal, with Iron and Pepsin]

	Metric	Old form
Glycerite of Pepsin	**200 mils**	**6 fl. oz. 192 min.**
Elixir of Cinchona Alkaloids and Iron, a sufficient quantity,		
To make	**1000 mils**	**2 pints**

Mix them and filter.

Average dose.—2 fluidrachms (8 mils).

ELIXIR CINCHONÆ ALKALOIDORUM, FERRI ET STRYCHNINÆ. N. F. Elixir of Cinchona Alkaloids, Iron and Strychnine

[Elix. Cinchon. Ferr. et Strych. Elixir Cinchonæ, Ferri et Strychninæ, N. F. III Elixir of Calisaya, Alkaloidal, with Iron and Strychnine]

	Metric	Old form
Strychnine Sulphate	**0.175 Gm.**	**2.5 gr.**
Distilled Water	**10.000 mils**	**2½ fl. dr.**
Elixir of Cinchona Alkaloids and Iron, a sufficient quantity,		
To make	**1000 mils**	**2 pints**

Dissolve the strychnine sulphate in the distilled water, add sufficient of the elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR CORYDALIS COMPOSITUM. N. F. Compound Elixir of Corydalis

[Elix. Coryd. Co.]

	Metric	Old form
Fluidextract of Corydalis	**60 mils**	1 fl. oz. 442 min.
Fluidextract of Stillingia	**60 mils**	1 fl. oz. 442 min.
Fluidextract of Xanthoxylum	**30 mils**	461 min.
Fluidextract of Blue Flag	**90 mils**	2 fl. oz. 7 fl. dr.
Alcohol	**125 mils**	4 fl. oz.
Potassium Iodide	**50 Gm.**	1 oz. av. 293 gr.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the fluidextracts, add the alcohol and dissolve the potassium iodide in the mixture. Then add sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR ERIODICTYI AROMATICUM. N. F. Aromatic Elixir of Eriodictyon

[Elix. Eriodict. Arom. Aromatic Elixir of Yerba Santa Elixir Corrigens]

	Metric	Old form
Fluidextract of Eriodictyon	**60 mils**	1 fl. oz. 442 min.
Syrup	**500 mils**	1 pint
Pumice, in fine powder	**30 Gm.**	1 oz. av.
Magnesium Carbonate	**10 Gm.**	146 gr.
Compound Elixir of Taraxacum	**440 mils**	14 fl. oz. 38 min.
To make	**1000 mils**	2 pints

Triturate the fluidextract with the pumice and the magnesium carbonate and gradually add the elixir, followed by the syrup Then shake the mixture frequently during two hours, allow it to stand over night and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR FERRI HYPOPHOSPHITIS. N. F. Elixir of Ferric Hypophosphite

[Elix. Ferr. Hypophos.]

	Metric	Old form
Ferric Hypophosphite	**16.5 Gm.**	241 gr.
Potassium Citrate	**21.5 Gm.**	314 gr.
Distilled Water	**35.0 mils**	1 fl. oz. 58 min.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the potassium citrate in the distilled water, add the ferric hypophosphite and heat the mixture gently until a clear solution is obtained. Then add sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.— 1 fluidrachm (4 mils).

ELIXIR FERRI LACTATIS. N. F. Elixir of Iron Lactate
[Elix. Ferr. Lact.]

	Metric	Old form
Ferrous Lactate	17.5 Gm.	255 gr.
Potassium Citrate	52.5 Gm.	1 oz. av. 329 gr.
Distilled Water	120.0 mils	3 fl. oz. 403 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the ferrous lactate and potassium citrate in the distilled water with the aid of a gentle heat. Then add enough aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR FERRI PHOSPHATIS. N. F. Elixir of Ferric Phosphate
[Elix. Ferr. Phos.]

	Metric	Old form
Ferric Phosphate	35 Gm.	1 oz. av. 74 gr.
Distilled Water	60 mils	1 fl. oz. 442 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the ferric phosphate in the distilled water with the aid of heat; then mix this solution with sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR FERRI PYROPHOSPHATIS. N. F. Elixir of Ferric Pyrophosphate
[Elix. Ferr. Pyrophos. Elixir of Pyrophosphate of Iron]

	Metric	Old form
Ferric Pyrophosphate	35 Gm.	1 oz. av. 74 gr.
Distilled Water	60 mils	1 fl. oz. 442 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the ferric pyrophosphate in the distilled water, with the aid of heat, add sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR FERRI PYROPHOSPHATIS, QUININÆ ET STRYCHNINÆ. N. F. Elixir of Ferric Pyrophosphate, Quinine and Strychnine
[Elix. Ferr. Pyrophos. Quin. et Strych.]

	Metric	Old form
Ferric Pyrophosphate	35.00 Gm.	1 oz. av. 74 gr.
Quinine Sulphate	8.75 Gm.	128 gr.
Strychnine	0.14 Gm.	2 gr.
Citric Acid	0.70 Gm.	10 gr.
Oil of Orange	0.70 mil	10 gr.
Alcohol	250.00 mils	8 fl. oz.
Syrup	375.00 mils	12 fl. oz.
Ammonia Water,		
Distilled Water, each, a sufficient quantity,		
To make	1000 mils	2 pints

Triturate the quinine sulphate, strychnine and citric acid together, until minutely divided, then add the alcohol and oil of orange. Warm the syrup to about 65° C. (149° F.) and add it to the turbid alcoholic mixture, and stir until it becomes clear. To this add the ferric pyrophos-

phate, previously dissolved in 320 mils [old form 10 fl. oz. 115 minims] of distilled water, and then ammonia water, drop by drop, until the liquid is neutral to litmus paper. Finally add sufficient distilled water to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR FERRI, QUININÆ ET STRYCHNINÆ. N. F. **Elixir of Iron, Quinine and Strychnine**

[Elix. Ferr. Quin. et Strych.]

	Metric	Old form
Tincture of Ferric Citro-Chloride	**125.000 mils**	4 fl. oz.
Quinine Hydrochloride	**8.750 Gm.**	128 gr.
Strychnine Sulphate	**0.175 Gm.**	2.5 gr.
Compound Spirit of Orange	**10.000 mils**	2½ fl. dr.
Alcohol	**240.000 mils**	7 fl. oz. 326 min.
Glycerin	**300.000 mils**	9 fl. oz. 288 min.
Purified Talc	**20.000 Gm.**	292 gr.
Distilled Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the quinine hydrochloride in the alcohol, add the compound spirit of orange, then the strychnine sulphate dissolved in 10 mils [old form 2½ fl. dr.] of distilled water, the glycerin, the tincture of ferric citro-chloride and then sufficient distilled water to make the product measure 1000 mils [old form 2 pints]. Finally add the purified talc and filter, returning the first portions of the filtrate until it passes through clear. Preserve the product in dark amber-colored bottles.

Average dose.—1 fluidrachm (4 mils).

ELIXIR FORMATUM. N. F. **Elixir of Formates**

[Elix. Format.]

	Metric	Old form
Potassium Carbonate	**41 Gm.**	1 oz. av. 161 gr.
Monohydrated Sodium Carbonate	**36 Gm.**	1 oz. av. 88 gr.
Formic Acid	**225 mils**	7 fl. oz. 96 min.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the potassium and sodium carbonates in the formic acid, add sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—2 fluidrachms (8 mils).

ELIXIR FORMATUM COMPOSITUM. N. F. **Compound Elixir of Formates**

[Elix. Format. Co.]

	Metric	Old form
Monohydrated Sodium Carbonate	**23.0 Gm.**	336 gr.
Magnesium Carbonate	**20.0 Gm.**	292 gr.
Strontium Carbonate	**25.0 Gm.**	365 gr.
Lithium Carbonate	**8.0 Gm.**	117 gr.
Quinine	**7.7 Gm.**	112 gr.
Formic Acid	**200.0 mils**	6 fl. oz. 192 min.
Compound Spirit of Cardamom	**5.0 mils**	77 min.
Acetic Ether	**2.0 mils**	31 min.
Alcohol	**100.0 mils**	3 fl. oz. 96 min.
Glycerin	**300.0 mils**	9 fl. oz. 288 min.
Purified Talc	**20.0 Gm.**	292 gr.
Distilled Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Add the formic acid to 300 mils [old form 9 fl. oz. 288 minims] of distilled water and in this dissolve the carbonates and afterwards the quinine. To this solution add the glycerin and alcohol, previously mixed with the compound spirit of cardamom and the acetic ether. Agitate the mixture thoroughly and add sufficient distilled water to make the product measure 1000 mils [old form 2 pints]. Then add the purified talc and filter, returning the first portions of the filtrate until it passes through clear.

Average dose.—2 fluidrachms (8 mils).

ELIXIR GENTIANÆ. N. F. Elixir of Gentian

[Elix. Gent.]

	Metric	Old form
Fluidextract of Gentian	**35 mils**	1 fl. oz. 58 min.
Compound Spirit of Cardamom	**15 mils**	230 min.
Sodium Citrate	**30 Gm.**	1 oz. av.
Glycerin	**50 mils**	1 fl. oz. 288 min.
Syrup	**250 mils**	8 fl. oz.
Alcohol	**200 mils**	6 fl. oz. 192 min.
Purified Talc	**20 Gm.**	292 gr.
Distilled Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the sodium citrate in 350 mils [old form 11 fl. oz. 96 minims] of distilled water, add this solution to the alcohol with which the compound spirit of cardamom has been mixed, then add the fluidextract of gentian, the syrup, the glycerin, and sufficient distilled water to make the product measure 1000 mils [old form 2 pints]. Incorporate the purified talc and filter, returning the first portions of the filtrate until it passes through clear.

The presence of sodium citrate in this elixir permits the addition of ferric salts without the production of a black color. In former revisions this preparation was treated with ferric hydroxide to precipitate the tannin-like constituents of the gentian so that the elixir could be mixed with ferric salts, but this treatment was laborious and also removed much of the bitterness of the gentian.

N. F. Preparations.—Elixir Gentianæ et Ferri; Elixir Gentianæ et Ferri Phosphatis.

Average dose.—1 fluidrachm (4 mils).

ELIXIR GENTIANÆ ET FERRI. N. F. Elixir of Gentian and Iron

[Elix. Gent. et Ferr. Elixir Gentianæ cum Tinctura Ferri Chloridi, N. F. III Elixir of Gentian with Tincture of Ferric Citro-Chloride]

	Metric	Old form
Tincture of Ferric Citro-Chloride	**100 mils**	3 fl. oz. 96 min.
Elixir of Gentian, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR GENTIANÆ ET FERRI PHOSPHATIS. N. F. **Elixir of Gentian and Ferric Phosphate**

[Elix. Gent. et Ferr. Phosph. ELIXIR GENTIANÆ FERRATUM]

	Metric	Old form
Ferric Phosphate	**17.5 Gm.**	255 gr.
Distilled Water	**35.0 mils**	1 fl. oz. 58 min.
Elixir of Gentian, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the ferric phosphate in the distilled water with the aid of heat, and add sufficient elixir of gentian to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils.)

ELIXIR GENTIANÆ GLYCERINATUM. N. F. **Glycerinated Elixir of Gentian**

[Elix. Gent. Glycerin.]

	Metric	Old form
Fluidextract of Gentian	**10.0 mils**	2½ fl. dr.
Fluidextract of Taraxacum	**15.0 mils**	230 min.
Acetic Ether	**0.5 mil**	8 min.
Phosphoric Acid	**5.0 mils**	77 min.
Tincture of Sweet Orange Peel	**15.0 mils**	230 min.
Compound Tincture of Cardamom	**60.0 mils**	1 fl. oz. 442 min.
Glycerin	**400.0 mils**	12 fl. oz. 384 min.
Sugar	**200.0 Gm.**	6 oz. av. 296 gr.
Sherry Wine, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the sugar in 325 mils [old form 10 fl. oz. 192 minims] of sherry wine, add the other ingredients, previously mixed, and sufficient sherry wine to make the product measure 1000 mils [old form 2 pints]. Allow the preparation to stand twenty-four hours and filter.

Average dose.—2 fluidrachms (8 mils).

ELIXIR GLYCEROPHOSPHATUM COMPOSITUM. N. F. **Compound Elixir of Glycerophosphates**

[Elix. Glycerophos. Co. COMPOUND SOLUTION OF GLYCEROPHOSPHATES]

	Metric	Old form
Solution of Sodium Glycerophosphate	**40.00 Gm.**	1 oz. av. 147 gr
Calcium Glycerophosphate	**16.00 Gm.**	234 gr.
Ferric Glycerophosphate	**3.00 Gm.**	44 gr.
Soluble Manganese Glycerophosphate	**2.00 Gm.**	29 gr.
Quinine Glycerophosphate	**1.00 Gm.**	15 gr.
Strychnine Glycerophosphate	**0.15 Gm.**	2 ⅓ gr.
Lactic Acid	**10.00 mils**	2½ fl. dr.
Compound Spirit of Cardamom	**2.00 mils**	31 min.
Alcohol	**125.00 mils**	4 fl. oz.
Glycerin	**350.00 mils**	11 fl. oz. 96 min.
Purified Talc	**20.00 Gm.**	292 gr.
Distilled Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Triturate the calcium glycerophosphate to a smooth paste with 100 mils [old form 3 fl. oz. 96 minims] of glycerin; dissolve the ferric and manganese salts, with the aid of a gentle heat, in 30 mils [old

form 461 minims] of distilled water, containing 4 mils [old form 1 fl. dr.] of the lactic acid. Now dissolve the strychnine and the quinine glycerophosphates in 100 mils [old form 3 fl. oz. 96 minims] of distilled water, containing the remainder of the lactic acid, then dissolve the sodium glycerophosphate in 30 mils [old form 461 minims] of hot distilled water and add all solutions to the calcium glycerophosphate mixture. Mix thoroughly and add the remainder of the glycerin, the alcohol, the compound spirit of cardamom and sufficient distilled water to make the product measure 1000 mils [old form 2 pints]. Add the purified talc, shake well and filter, returning the first portions of the filtrate until it passes through clear.

Average dose.—2 fluidrachms (8 mils).

ELIXIR GLYCYRRHIZÆ AQUOSUM. N. F. **Aqueous Elixir of Glycyrrhiza**

[Elix. Glycyrrh. Aq. AQUEOUS ELIXIR OF LICORICE]

	Metric	Old form
Fluidextract of Glycyrrhiza	**150 mils**	4 fl. oz. 384 min.
Compound Spirit of Cardamom	**5 mils**	77 min.
Stronger Orange Flower Water	**200 mils**	6 fl. oz. 192 min.
Glycerin	**150 mils**	4 fl. oz. 384 min.
Syrup	**150 mils**	4 fl. oz. 384 min.
Distilled Water, a sufficient quantity,		
To make	**1000 mils**	**2 pints**

Mix and filter.

Average dose.—2 fluidrachms (8 mils).

ELIXIR GLYCYRRHIZÆ AROMATICUM. N. F. **Aromatic Elixir of Glycyrrhiza**

[Elix. Glycyrrh. Arom. AROMATIC ELIXIR OF LICORICE]

	Metric	Old form
Fluidextract of Glycyrrhiza	**125.00 mils**	4 fl. oz.
Oil of Clove	**0.75 mil**	12 min.
Oil of Cinnamon	**0.75 mil**	12 min.
Oil of Myristica	**0.50 mil**	8 min.
Oil of Fennel	**1.50 mils**	23 min.
Purified Talc	**20.00 Gm.**	292 gr.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Triturate the oils with the purified talc, gradually add the fluidextract and sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints]. Allow the mixture to stand over night and filter, returning the first portions of the filtrate until it passes through clear.

Average dose.—2 fluidrachms (8 mils).

ELIXIR GUARANÆ. N. F. **Elixir of Guarana**

[Elix. Guar.]

	Metric	Old form
Fluidextract of Guarana	**200 mils**	6 fl. oz. 192 min.
Aromatic Elixir	**200 mils**	6 fl. oz. 192 min.
Compound Elixir of Taraxacum, a sufficient quantity,		
To make	**1000 mils**	**2 pints**

Mix them; allow the mixture to stand over night and then filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR HUMULI. N. F. Elixir of Hops

[Elix. Humul.]

	Metric	Old form
Fluidextract of Hops	125 mils	4 fl. oz.
Tincture of Vanilla	30 mils	461 min.
Compound Elixir of Taraxacum	125 mils	4 fl. oz.
Purified Talc	20 Gm.	292 gr.
Aromatic Elixir, a sufficient quantity,		
To make	1000 mils	2 pints

Triturate the fluidextract of hops with the purified talc, then gradually add the compound elixir of taraxacum, the tincture of vanilla and sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints]. Allow the mixture to stand over night and then filter, returning the first portions of the filtrate until it passes through clear.

Average dose.—2 fluidrachms (8 mils).

ELIXIR HYPOPHOSPHITUM. N. F. Elixir of Hypophosphites

[Elix. Hypophos.]

	Metric	Old form
Calcium Hypophosphite	52.5 Gm.	1 oz. av. 329 gr.
Sodium Hypophosphite	17.5 Gm.	255 gr.
Potassium Hypophosphite	17.5 Gm.	255 gr.
Hypophosphorous Acid	4.0 mils	1 fl. dr.
Distilled Water	420.0 mils	13 fl. oz. 211 min.
Glycerin	30.0 mils	461 min.
Compound Spirit of Cardamom	0.6 mil	9 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the hypophosphites in the distilled water to which the acid has been added; then add the glycerin, the compound spirit of cardamom and sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—2 fluidrachms (8 mils).

ELIXIR HYPOPHOSPHITUM ET FERRI. N. F. Elixir of Hypophosphites and Iron

[Elix. Hypophos. et Ferr.]

	Metric	Old form
Calcium Hypophosphite	17.50 Gm.	255 gr.
Sodium Hypophosphite	17.50 Gm.	255 gr.
Potassium Hypophosphite	8.75 Gm.	128 gr.
Ferric Hypophosphite	8.75 Gm.	128 gr.
Potassium Citrate	11.00 Gm.	161 gr.
Hypophosphorous Acid	4.00 mils	1 fl. dr.
Distilled Water	250.00 mils	8 fl. oz.
Syrup	250.00 mils	8 fl. oz.
Aromatic Elixir, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the ferric hypophosphite and the potassium citrate in 50 mils [old form 1 fl. oz. 288 minims] of warm distilled water and add the syrup. Dissolve the other hypophosphites in the remainder of

the distilled water and mix the two solutions. Finally add the acid and sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter. Store the product in dark amber-colored bottles.

Average dose.—2 fluidrachms (8 mils).

ELIXIR LITHII BROMIDI. N. F. Elixir of Lithium Bromide

[Elix. Lith. Brom.]

	Metric	Old form
Lithium Bromide	**85 Gm.**	2 oz. av. 366 gr.
Syrup	**200 mils**	6 fl. oz. 192 min.
Distilled Water	**460 mils**	14 fl. oz. 346 min.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the lithium bromide in the distilled water, add the syrup and sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—2 fluidrachms (8 mils).

ELIXIR LITHII CITRATIS. N. F. Elixir of Lithium Citrate

[Elix. Lith. Cit.]

	Metric	Old form
Lithium Citrate	**85 Gm.**	2 oz. av. 366 gr.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the lithium citrate in sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—2 fluidrachms (8 mils).

ELIXIR LITHII SALICYLATIS. N. F. Elixir of Lithium Salicylate

[Elix. Lith. Sal.]

	Metric	Old form
Lithium Salicylate	**85 Gm.**	2 oz. av. 366 gr.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the lithium salicylate in sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—2 fluidrachms (8 mils).

ELIXIR PEPSINI. N. F. Elixir of Pepsin

[Elix. Pepsin.]

	Metric	Old form
Glycerite of Pepsin	**200 mils**	6 fl. oz. 192 min.
Glycerin	**100 mils**	3 fl. oz. 96 min.
Hydrochloric Acid	**4 mils**	1 fl. dr.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the glycerite of pepsin, glycerin and hydrochloric acid, add sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

N. F. Preparation.—Elixir Pepsini et Ferri.

Average dose.—2 fluidrachms (8 mils).

ELIXIR PEPSINI, BISMUTHI ET STRYCHNINÆ. N. F. Elixir of Pepsin, Bismuth and Strychnine

[Elix. Pepsin. Bism. et Strych.]

	Metric	Old form
Strychnine	**0.175 Gm.**	2.5 gr.
Tartaric Acid	**0.175 Gm.**	2.5 gr.
Elixir of Pepsin and Bismuth, a sufficient quantity,		
To make	**1000 mils**	2 pints

Triturate the strychnine and tartaric acid with 30 mils [old form 461 minims] of the elixir, until dissolved, then add the remainder of the elixir, mix well, and filter.

This elixir should be frequently prepared as its digestive power deteriorates rapidly.

Average dose.—1 fluidrachm (4 mils).

ELIXIR PEPSINI ET BISMUTHI. N. F. Elixir of Pepsin and Bismuth

[Elix. Pepsin. et Bism.]

	Metric	Old form
Pepsin	**8.5 Gm.**	124 gr.
Glycerin	**125.0 mils**	4 fl. oz.
Glycerite of Bismuth	**125.0 mils**	4 fl. oz.
Distilled Water	**250.0 mils**	8 fl. oz.
Tincture of Caramel	**5.0 mils**	77 min.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the pepsin in the glycerin and distilled water; add the glycerite of bismuth and 490 mils [old form 15 fl. oz. 326 minims] of aromatic elixir and, if decidedly acid, nearly neutralize the mixture with solution of sodium hydroxide. Finally add the tincture of caramel and sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints], mix well and filter.

This elixir should be frequently prepared as its digestive power deteriorates rapidly.

N. F. Preparation.—Elixir Pepsini, Bismuthi et Strychninæ.

Average dose.—2 fluidrachms (8 mils).

ELIXIR PEPSINI ET FERRI. N. F. Elixir of Pepsin and Iron

[Elix. Pepsin. et Ferr.]

	Metric	Old form
Tincture of Ferric Citro-Chloride	**75 mils**	2 fl. oz. 192 min.
Elixir of Pepsin, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix them and filter.

Average dose.—2 fluidrachms (8 mils).

ELIXIR PEPSINI ET RENNINI COMPOSITUM. N. F. Compound Elixir of Pepsin and Rennin

[Elix. Pepsin. et Rennin. Co. Essentia Pepsini, N. F. III]

	Metric	Old form
Pepsin	**22.5 Gm.**	328 gr.
Rennin	**16.5 Gm.**	241 gr.
Lactic Acid	**2.0 mils**	31 min.
Tincture of Sweet Orange Peel	**15.0 mils**	230 min.
Glycerin	**150.0 mils**	4 fl. oz. 384 min.
Alcohol	**200.0 mils**	6 fl. oz. 192 min.
Oil of Myristica	**0.1 mil**	1½ min.
Purified Talc	**20.0 Gm.**	292 gr.
Distilled Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the pepsin and rennin with 300 mils [old form 9 fl. oz. 288 minims] of distilled water, add the lactic acid and glycerin, allow the mixture to stand with occasional gentle agitation until solution is effected and then add the tincture of sweet orange peel, the oil of myristica and the alcohol, previously mixed. The latter should be added in portions, shaking the mixture gently after each addition, and finally add sufficient distill d water to make the product measure 1000 mils [old form 2 pints]. Add the purified talc, allow the mixture to stand, with occasional gentle agitation during twenty-four hours, and filter, returning the first portions of the filtrate until it passes through clear.

Average dose.—2 fluidrachms (8 mils).

ELIXIR PHOSPHORI. N. F. Elixir of Phosphorus

[Elix. Phosphor.]

	Metric	Old form
Phosphorus	**0.25 Gm.**	4 gr.
Chloroform	**5.00 mils**	77 min.
Alcohol	**340.00 mils**	10 fl. oz. 422 min.
Glycerin	**300.00 mils**	9 fl. oz. 288 min.
Compound Spirit of Orange	**10.00 mils**	2½ fl. dr.
Oil of Anise	**2.00 mils**	31 min.
Purified Talc	**30.00 Gm.**	1 oz. av.
Distilled Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Weigh the phosphorus in a tared watch-crystal containing water, then dry it carefully and quickly with blotting paper and introduce it into a strong flask or bottle of 100 mils [old form 3 fl. oz. 96 minims] capacity containing the chloroform. Stopper the container, warm it on a water bath until the phosphorus melts into a globule and agitate it thoroughly, repeating the operation, if necessary, until the phosphorus is all dissolved. Add the chloroform solution to the alcohol, which has been warmed to from 55° to 60° C. (131° to 140° F.) in a bottle graduated to 1000 mils [old form 2 pints], shake it thoroughly, add the oil of anise, the compound spirit of orange and the glycerin in divided portions, shaking the mixture after each addition, and then add sufficient distilled water to make the product measure 1000 mils [old form 2 pints]. Finally add the purified talc and filter, returning the first portions of the filtrate until it passes through clear.

N. F. Preparation.—Elixir Phosphori et Nucis Vomicæ.

Average dose.—1 fluidrachm (4 mils).

ELIXIR PHOSPHORI ET NUCIS VOMICÆ. N. F. **Elixir of Phosphorus and Nux Vomica**

[Elix. Phosphor. et Nuc. Vom.]

	Metric	Old form
Tincture of Nux Vomica	**3.5 mils**	135 min.
Elixir of Phosphorus, a sufficient quantity,		
To make	**100 mils**	8 fl. oz.

Mix them.

Average dose.—1 fluidrachm (4 mils).

ELIXIR POTASSII ACETATIS. N. F. **Elixir of Potassium Acetate**

[Elix. Pot. Acet.]

	Metric	Old form
Potassium Acetate	**85 Gm.**	2 oz. av. 366 gr.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the potassium acetate in sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—4 fluidrachms (15 mils).

ELIXIR POTASSII ACETATIS ET JUNIPERI. N. F. **Elixir of Potassium Acetate and Juniper**

[Elix. Pot. Acet. et Junip.]

	Metric	Old form
Potassium Acetate	**85 Gm.**	2 oz. av. 366 gr.
Fluidextract of Juniper	**125 mils**	4 fl. oz.
Purified Talc	**20 Gm.**	292 gr.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the fluidextract of juniper with 750 mils [old form 24 fl. oz.] of aromatic elixir, in which the potassium acetate has been dissolved, and then add sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints]. Add the purified talc, allow the mixture to stand for twelve hours with occasional agitation, and filter, returning the first portions of the filtrate until it passes through clear.

Average dose.—4 fluidrachms (15 mils).

ELIXIR POTASSII BROMIDI. N. F. **Elixir of Potassium Bromide**

[Elix. Pot. Brom.]

	Metric	Old form
Potassium Bromide	**175 Gm.**	5 oz. av. 368 gr.
Syrup	**200 mils**	6 fl. oz. 192 min.
Distilled Water	**460 mils**	14 fl. oz. 346 min.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the potassium bromide in the distilled water, add the syrup and sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

NOTE.—If a colored elixir is preferred add 15 mils [old form 230 minims] of compound tincture of cudbear in place of the same quantity of aromatic elixir.

Average dose.—2 fluidrachms (8 mils).

ELIXIR QUININÆ VALERATIS ET STRYCHNINÆ. N. F. Elixir of Quinine Valerate and Strychnine

[Elix. Quin. Valer. et Strych. ELIXIR QUININÆ VALERIANATIS ET STRYCHNINÆ, N. F. III]

	Metric	Old form
Quinine Valerate	17.500 Gm.	255 gr.
Strychnine Sulphate	0.175 Gm.	2.5 gr.
Compound Tincture of Cudbear	15.000 mils	230 min.
Distilled Water	5.000 mils	77 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the strychnine sulphate in the d stilled water, mix this solution with 800 mils [o d form 25 fl. oz. 288 minims] of aromatic elixir, and dissolve the quinine valerate in this mixture. Then add the compound tincture of cudbear, and sufficient aromatic elixir to make the product measure 1000 mils and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR RUBI COMPOSITUM. N. F. Compound Elixir of Blackberry

[Elix. Rubi Co.]

	Metric	Old form
Rubus, in No. 40 powder	16 Gm.	234 gr.
Nutgall, in No. 40 powder	16 Gm.	234 gr.
Saigon Cinnamon, in No. 40 powder	16 Gm.	234 gr.
Clove, in No. 40 powder	4 Gm.	58 gr.
Mace, in No. 40 powder	2 Gm.	29 gr.
Jamaica Ginger, in No. 40 powder	2 Gm.	29 gr.
Syrup of Blackberry Fruit	750 mils	24 fl. oz.
Diluted Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Moisten the mixed drugs with diluted alcohol, pack them firmly in a cylindrical percolator and percolate with the same menstruum, in the usual manner, until the percolate measures 250 mils [old form 8 fl. oz.]. To the percolate add the syrup of blackberry fruit, and mix thoroughly; allow it to stand for several days, and filter.

Average dose.—4 fluidrachms (15 mils).

ELIXIR SODII BROMIDI. N. F. Elixir of Sodium Bromide

[Elix. Sod. Brom.]

	Metric	Old form
Sodium Bromide	175 Gm.	5 oz. av. 368 gr.
Syrup	200 mils	6 fl. oz. 192 min.
Distilled Water	460 mils	14 fl. oz. 346 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the sodium bromide in the distilled water, add the syrup and sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—2 fluidrachms (8 mils).

ELIXIR SODII HYPOPHOSPHITIS. N. F. **Elixir of Sodium Hypophosphite**

[Elix. Sod. Hypophos.]

	Metric	Old form
Sodium Hypophosphite	**35 Gm.**	1 oz. av. 74 gr.
Hypophosphorous Acid	**4 mils**	1 fl. dr.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the sodium hypophosphite in 825 mils [old form 26 fl. oz. 192 minims] of aromatic elixir. Then add the acid and sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR SODII SALICYLATIS. N. F. **Elixir of Sodium Salicylate**

[Elix. Sod. Sal.]

	Metric	Old form
Sodium Salicylate	**85 Gm.**	2 oz. av. 366 gr.
Syrup	**200 mils**	6 fl. oz. 192 min.
Distilled Water	**460 mils**	14 fl. oz. 346 min.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the sodium salicylate in the distilled water, add the syrup and sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR SODII SALICYLATIS COMPOSITUM. N. F. **Compound Elixir of Sodium Salicylate**

[Elix. Sod. Sal. Co.]

	Metric	Old form
Sodium Salicylate	**80 Gm.**	2 oz. av. 293 gr.
Fluidextract of Cimicifuga	**32 mils**	1 fl. oz. 12 min.
Fluidextract of Gelsemium	**16 mils**	246 min.
Potassium Iodide	**15 Gm.**	219 gr.
Purified Talc	**20 Gm.**	292 gr.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the sodium salicylate and potassium iodide in 800 mils [old form 25 fl. oz. 288 minims] of aromatic elixir, add the fluidextracts and then sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints]. Then incorporate the purified talc, mix and filter, returning the first portions of the filtrate until it passes through clear. Store the product in dark amber-colored bottles.

Average dose.—1 fluidrachm (4 mils).

ELIXIR STRYCHNINÆ VALERATIS. N. F. **Elixir of Strychnine Valerate**

[Elix. Strych. Valer. ELIXIR STRYCHNINÆ VALERIANATIS, N. F. III]

	Metric	Old form
Strychnine Valerate	**0.175 Gm.**	2.5 gr.
Distilled Water	**5.000 mils**	77 min.
Tincture of Vanilla	**15.000 mils**	230 min.
Compound Tincture of Cudbear	**15.000 mils**	230 min.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the strychnine valerate in the distilled water, with the aid of heat, mix this solution thoroughly with 900 mils [old form 28 fl. oz. 384 minims] of aromatic elixir, add the tinctures, and finally sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR TARAXACI COMPOSITUM. N. F. **Compound Elixir of Taraxacum**

[Elix. Tarax. Co.]

	Metric	Old form
Fluidextract of Taraxacum	35 mils	1 fl. oz. 58 min.
Fluidextract of Wild Cherry	20 mils	5 fl. dr.
Fluidextract of Glycyrrhiza	60 mils	1 fl. oz. 442 min.
Tincture of Sweet Orange Peel	60 mils	1 fl. oz. 442 min.
Tincture of Cinnamon	30 mils	461 min.
Compound Tincture of Cardamom	30 mils	461 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the fluidextracts, add the tinctures, and then sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints]. Allow it to stand during twelve hours and filter.

N. F. Preparations.—Elixir Eriodictyi Aromaticum; Elixir Guaranæ; Elixir Humuli; Elixir Viburni Opuli Compositum.

Average dose.—2 fluidrachms (8 mils).

ELIXIR TERPINI HYDRATIS. N. F. **Elixir of Terpin Hydrate**

[Elix. Terpin. Hyd.]

	Metric	Old form
Terpin Hydrate, in fine powder	17.5 Gm.	255 gr.
Tincture of Sweet Orange Peel	20.0 mils	5 fl. dr.
Spirit of Bitter Almond	5.0 mils	77 min.
Alcohol	425.0 mils	13 fl. oz. 288 min.
Glycerin	400.0 mils	12 fl. oz. 384 min.
Syrup	100.0 mils	3 fl. oz. 96 min.
Distilled Water, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the terpin hydrate in the alcohol, add successively the tincture, spirit, glycerin, syrup and sufficient distilled water to make the product measure 1000 mils [old form 2 pints] and filter.

The high alcoholic content in this elixir is required for the solution of the terpin hydrate.

N. F. Preparations.—Elixir Terpini Hydratis et Diacetylmorphinæ; Elixir Terpini Hydratis et Codeinæ.

Average dose.—1 fluidrachm (4 mils).

ELIXIR TERPINI HYDRATIS ET CODEINÆ. N. F. **Elixir of Terpin Hydrate and Codeine**

[Elix. Terpin. Hyd. et Codein.]

	Metric	Old form
Codeine	2 Gm.	29 gr.
Elixir of Terpin Hydrate, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the codeine in sufficient of the elixir to measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR TERPINI HYDRATIS ET DIACETYLMORPHINÆ. N. F. **Elixir of Terpin Hydrate and Diacetylmorphine**

[Elix. Terpin. Hyd. et Diacetylmorph. ELIXIR TERPINI HYDRATIS CUM HEROINA, N. F. III]

	Metric	Old form
Diacetylmorphine Hydrochloride	0.27 Gm.	4 gr.
Elixir of Terpin Hydrate, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the diacetylmorphine hydrochloride in sufficient of the elixir to measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR TRIUM BROMIDORUM. N. F. **Elixir of Three Bromides**

[Elix. Tri. Brom.]

	Metric	Old form
Ammonium Bromide	80 Gm.	2 oz. av. 293 gr.
Potassium Bromide	80 Gm.	2 oz. av. 293 gr.
Sodium Bromide	80 Gm.	2 oz. av. 293 gr.
Cudbear	2 Gm.	29 gr.
Compound Elixir of Almond, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the bromide in 800 mils [old form 25 fl. oz. 288 minims] of compound elixir of almond, add the cudbear and allow the mixture to macerate in a stoppered bottle for six hours, with occasional shaking; then add sufficient compound elixir of almond to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR VANILLINI COMPOSITUM. N. F. **Compound Elixir of Vanillin**

[Elix. Vanil. Co.]

	Metric	Old form
Compound Spirit of Vanillin	20 mils	5 fl. dr.
Alcohol	80 mils	2 fl. oz. 269 min.
Glycerin	25 mils	384 min.
Syrup	300 mils	9 fl. oz. 288 min.
Purified Talc	20 Gm.	292 gr.
Tincture of Caramel	20 mils	5 fl. dr.
Distilled Water, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the compound spirit of vanillin with the alcohol, add the glycerin, and then the syrup and 555 mils [old form 17 fl. oz. 365 minims] of distilled water, in several portions, shaking the mixture thoroughly after each addition. Then add the tincture of caramel and sufficient distilled water to make the product measure 1000 mils [old form 2 pints]. Add the purified talc and filter, returning the first portions of the filtrate until it passes through clear. This preparation offers a pleasantly flavored vehicle of low alcoholic content.

ELIXIR VIBURNI OPULI COMPOSITUM. N. F. Compound Elixir of Viburnum Opulus

[Elix. Viburn. Opul. Co.]

	Metric	Old form
Fluidextract of Viburnum Opulus	**75 mils**	2 fl. oz. 192 min.
Fluidextract of Trillium	**150 mils**	4 fl. oz. 384 min.
Fluidextract of Aletris	**75 mils**	2 fl. oz. 192 min.
Compound Elixir of Taraxacum, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the fluidextracts with the elixir; allow the mixture to stand during twelve hours and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR VIBURNI PRUNIFOLII. N. F. Elixir of Viburnum Prunifolium

[Elix. Viburn. Prun. Elixir of Black Haw]

	Metric	Old form
Fluidextract of Viburnum Prunifolium	**125 mils**	4 fl. oz.
Compound Tincture of Cardamom	**75 mils**	2 fl. oz. 192 min.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix them, allow the product to stand during twelve hours and filter.

Average dose.—1 fluidrachm (4 mils).

ELIXIR ZINCI VALERATIS. N. F. Elixir of Zinc Valerate

[Elix. Zinc. Valer. Elixir Zinci Valerianatis, N. F. III]

	Metric	Old form
Zinc Valerate	**17.5 Gm.**	255 gr.
Citric Acid	**56.0 Gm.**	1 oz. av. 380 gr.
Alcohol	**125.0 mils**	4 fl. oz.
Spirit of Bitter Almond	**10.0 mils**	2½ fl. dr.
Compound Tincture of Cudbear	**15.0 mils**	230 min.
Stronger Ammonia Water,		
Distilled Water,		
Aromatic Elixir, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Neutralize the citric acid with the stronger ammonia water and add sufficient distilled water to make 100 mils [old form 3 fl. oz. 96 minims] of solution. Add 250 mils [old form 8 fl. oz.] of aromatic elixir and the alcohol, and dissolve the zinc valerate in this mixture. Then add the spirit of bitter almond, the compound tincture of cudbear, and finally sufficient aromatic elixir to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

Cordialia *Cordials*

Cordials as a class are closely related to the elixirs, being pleasantly flavored preparations intended for internal administration. Only *one* representative of this class is recognized. It is as follows:

CORDIALE RUBI FRUCTUS. N. F. Blackberry Cordial
[Cord. Rubi Fruct.]

	Metric	Old form
Saigon Cinnamon, in No. 40 powder	20 Gm.	292 gr.
Clove, in No. 40 powder	5 Gm.	73 gr.
Myristica, in No. 40 powder	5 Gm.	73 gr.
Purified Talc	8 Gm.	117 gr.
Syrup of Blackberry Fruit, **Diluted Alcohol,** each, a sufficient quantity,		
To make	1000 mils	2 pints

Pack the mixed drugs firmly in a cylindrical glass percolator and pour on diluted alcohol until the percolate measures 250 mils [old form 8 fl. oz.]; to this add sufficient syrup of blackberry fruit to make the product measure 1000 mils [old form 2 pints], mix, add the purified talc and filter.

Average dose.—2 fluidrachms (8 mils).

QUESTIONS ON ALCOHOLIC SOLUTIONS

In pharmacy, what are spirits? (See page 382.)
In how many different ways are the spirits made?
How many are official in the U. S. P.? How many in the N. F.?
What is the most usual method of making them?
How many of them are made in this way?
In making spirits, what is the object of maceration?
What spirit, formerly official, was made by gaseous solution? Which official spirit involves a chemical reaction?
What formerly official spirits were made by distillation?
Where spirits can be made either by distillation or by solution, which is the better process, and why?
Give the formula and process for making spirit of ether.
What is the official name in Latin and in English and the synonym?
What is spirit of nitrous ether?
How much ethyl nitrite should it contain?
What is the formula in symbols and molecular weight of ethyl nitrite?
How is ethyl nitrite produced?
What is its popular name or synonym?
How should this spirit be preserved and why?
What is aromatic spirit of ammonia?
How is it prepared?
Why are the ammonium carbonate and ammonia water allowed to stand for twelve hours before adding to the alcohol?
What is the Latin name of spirit of bitter almond?
How is it made? For what is it used?
Give the official name, formula, and method for making spirit of anise. Compound spirit of orange. Spirit of camphor. Spirit of chloroform. Spirit of cinnamon.
How much camphor should be present in the spirit? Describe the assay process for this spirit.
What is the Latin name of spirit of nitroglycerin? What are the synonyms?
How much nitroglycerin does it contain?
What is the chemical name of nitroglycerin?
Why should great care be exercised in using this preparation? What should be done if it is spilled? Why?
What is the specific gravity of spirit of nitroglycerin? How is spirit of juniper prepared? Compound spirit of juniper? Spirit of Lavender?
Give the formula and method for preparing spirit of peppermint.
Give the formula and method for preparing spirit of spearmint.
How is spirit of formic acid made? What is its synonym?
What is "Hoffmann's Anodyne"? How does it differ from "Hoffmann's drops"?
Name the ingredients in anisated spirit of ammonia; in compound spirit of cardamom. What are the preparations made from the latter spirit?

What are the common names by which compound spirit of myrcia and perfumed spirit are sold?
What are elixirs?
Why should care be taken in selecting the flavoring ingredients?
What is aromatic elixir used for?
How is it made?
What is the formula for elixir of glycyrrhiza? For what is it used?
What are the synonyms for elixir of glycyrrhiza?
Name all of the elixirs containing bromides, official in the N. F.
What is the dose of bromide in each teaspoonful of these elixirs?
Why do these elixirs of bromides contain small percentages of alcohol?
Why is ammonia directed to be in excess in elixir of ammonium valerate?
What are the uses and advantages of compound elixir of almond?
Name the several elixirs of the U. S. P. and N. F. which are available for the physician's use as vehicles or pleasantly flavored solvents, in prescription writing.
What are the synonyms for red aromatic elixir and for elixir of bitter orange?
How is elixir of bismuth made?
Name the several elixirs containing buchu. How are they made?
What elixirs containing calcium salts are official in the N. F.?
What are the advantages and uses of compound spirit of cardamom and of compound spirit of vanillin?
Give the Latin title for "laxative elixir."
Why was an elixir of cinchona alkaloid introduced into the N. F. replacing the former elixir of cinchona, made directly from the bark?
Name the N. F. elixirs containing cinchona alkaloids.
How is elixir of ferric pyrophosphate, quinine and strychnine made? Elixir of iron, quinine and strychnine?
Name the ingredients in compound elixir of formates.
How is elixir of gentian prepared?
Gentian preparations usually produce a black color when mixed with ferric salts; will this occur in the elixir of gentian and iron?
Name the ingredients in the compound elixir of glycerophosphates.
How is elixir of pepsin made? Name the N. F. elixirs containing pepsin.
What is the common name for compound elixir of pepsin and rennin?
Name the ingredients in this elixir.
How much phosphorus is contained in a teaspoonful of elixir of phosphorus? How is it made?
How is elixir of terpin hydrate made? Why is this elixir so strongly alcoholic?
What amount of heroin is present in each teaspoonful of elixir of terpin hydrate and diacetylmorphine? How much codeine in a teaspoonful of elixir of terpin hydrate and codeine?
How much of the combined bromides in each teaspoonful of elixir of three bromides?
Name the ingredients in blackberry cordial.

CHAPTER XXIV

ETHEREAL SOLUTIONS

Collodia *Collodions*

COLLODIONS are liquid preparations intended for external use, having for their base a solution of pyroxylin, or gun-cotton, in a mixture of ether and alcohol. (For a description of the properties of pyroxylin see Part IV.) Collodions are applied to the skin by means of a soft brush, and when the ether and alcohol evaporate, a film is left on the surface, which either acts as a protection or brings a medicating agent in contact with the epidermis. *Three* collodions are official in the U. S. P. IX and *five* in the N. F. IV.

Collodions of the U. S. P. IX

Title	Ingredients	Method of Preparation
Collodium	40 Gm. Pyroxylin; 750 mils Ether; 250 mils Alcohol	Shake the Pyroxylin with the Alcohol in a bottle, add the Ether and again shake the mixture until solution results. Stand it aside until clear and decant the clear portion
Cantharidatum	60 Gm. Cantharides, in fine powder; 5 mils Glacial Acetic Acid; 85 Gm. Flexible Collodion; Acetone, enough to make 100 Gm.	Macerate the Cantharides with 55 mils of Acetone and the Glacial Acetic Acid during 24 hours, in a closely covered container. Then percolate with Acetone until the Cantharides is exhausted. Evaporate the percolate on a water bath to 15 Gm. and mix this with the Flexible Collodion. Decant the clear liquid after the sediment has deposited
Flexile	950 Gm. Collodion; 20 Gm. Camphor; 30 Gm. Castor Oil	Weigh the ingredients successively into a tared bottle and shake the mixture until the Camphor dissolves

Collodions of the N. F. IV

Title	Ingredients	Method of Preparation
Collodium Iodi	5 Gm. Iodine; 95 Gm. Flexible Collodion	Dissolve the Iodine in the Collodion, in a bottle, by agitation
Iodoformi	5 Gm. Iodoform; 95 Gm. Flexible Collodion	Dissolve the Iodoform in the Collodion, in a bottle, by agitation
Salicylici Compositum	11 Gm. Salicylic Acid; 10 Gm. Fluidextract of Cannabis; Flexible Collodion, enough to make 100 Gm.	Dissolve the Salicylic Acid in 75 mils of Flexible Collodion, add the Fluidextract and enough of the Collodion to make 100 Gm.
Stypticum	20 Gm. Tannic Acid; 80 Gm. Flexible Collodion	Dissolve the Tannic Acid in the Collodion, in a bottle, by agitation
Tiglii	10 Gm. Croton Oil; 90 Gm. Flexible Collodion	Mix them

COLLODIUM. U. S. **Collodion**

[Collod.]

	Metric	Old form
Pyroxylin	**40 Gm.**	1 oz. av. 147 gr.
Ether	**750 mils**	24 fl. oz.
Alcohol	**250 mils**	8 fl. oz.
To make about	**1000 mils**	2 pints

Add the alcohol to the pyroxylin contained in a suitable bottle, shake the mixture thoroughly, then introduce the ether, and again shake the mixture until the pyroxylin is dissolved. Cork the bottle well and set it aside until the liquid becomes clear. Finally decant the clear portion from any sediment which may have deposited, and transfer it to containers which must be well closed.

Keep the collodion in a cool place remote from fire.

Official Description.—A clear, or slightly opalescent, syrupy liquid; colorless, or slightly yellowish.

Odor, Taste and Reaction.—It has the odor of ether; is highly inflammable, and when exposed to the air in a thin layer it leaves a transparent, tenacious film; shaken with an equal volume of distilled water, the aqueous liquid is not acid to litmus.

Specific Gravity.—0.765 to 0.775 at 25° C. (77° F.)

Tests for Identity.—When mixed with an equal volume of distilled water, a viscid, stringy mass separates.

Assay.—Introduce about 10 mils of Collodion into a flask; stopper and weigh accurately, then warm it on a water bath and add 10 mils of distilled water, drop by drop, with constant stirring. Evaporate the mixture on a water bath and dry the residue to constant weight at 110° C. (230° F.). The pyroxylin so obtained corresponds to not less than 5.1 per cent. of the Collodion taken, equal to about 4 Gm. of pyroxylin in 100 mils of Collodion at 25° C. (77° F.). The pyroxylin obtained burns rapidly, with a yellow flame.

U. S. P. Preparation.—Collodium Flexile.

COLLODIUM CANTHARIDATUM. U. S. Cantharidal Collodion

[Collod. Canth. Blistering Collodion Vesicating Collodion]

	Metric	Old form
*Cantharides, in fine powder	60 Gm.	2 oz. av. 51 gr.
Glacial Acetic Acid	5 mils	81 min.
Flexible Collodion	85 Gm.	2 oz. av. 437 min.
Acetone, a sufficient quantity,		
To make	100 Gm.	3 oz. av. 231 gr.

Mix the cantharides with 55 mils [old form 1 fl. oz. 413 minims] of acetone, to which the glacial acetic acid has been added, and set the mixture aside in a closely-covered container for twenty-four hours. Then transfer it to a percolator and continue the percolation with acetone until the drug is practically exhausted. Reduce the percolate by distillation on a water bath, in a tared flask to 15 Gm. [old form 230 grains] and, when cold, dissolve this concentrated extract in 85 Gm. [old form 2 oz. av. 437 min.] of flexible collodion. Finally allow the solution to stand for several hours, and decant the clear liquid from any sediment which may have deposited, and transfer the product to containers, which must be well-closed.

Keep Cantharidal Collodion in a cool place, remote from fire.

COLLODIUM FLEXILE. U. S. Flexible Collodion

[Collod. Flex.]

	Metric	Old form
*Collodion	950 Gm.	33 oz. av. 223 gr.
Camphor	20 Gm.	309 gr.
Castor Oil	30 Gm.	1 oz. av. 25 gr.
To make	1000 Gm.	35 oz. av. 120 gr.

Weigh the ingredients, successively, into a tared bottle and shake the mixture until the camphor is dissolved. Keep the product in well-closed containers, in a cool place, remote from fire.

U. S. P. Preparation.—Collodium Cantharidatum.

N. F. Preparations.—Collodium Iodi; Collodium Iodoformi; Collodium Salicylici Compositum; Collodium Stypticum; Collodium Tiglii.

COLLODIUM IODI. N. F. Iodine Collodion

[Collod. Iodi]

	Metric	Old form
Iodine, reduced to powder	5 Gm.	87½ gr.
Flexible Collodion	95 Gm.	3 oz. av. 350 gr.
To make	100 Gm.	4 oz. av.

Add the iodine to the flexible collodion in a bottle and agitate the mixture frequently until the iodine is dissolved.

COLLODIUM IODOFORMI. N. F. Iodoform Collodion

[Collod. Iodof.]

	Metric	Old form
Iodoform, in fine powder	5 Gm.	87½ gr.
Flexible Collodion	95 Gm.	3 oz. av. 350 gr.
To make	100 Gm.	4 oz av.

Add the iodoform to the flexible collodion in a bottle and agitate the mixture until the iodoform is dissolved.

COLLODIUM SALICYLICI COMPOSITUM. N. F. Compound Salicylic Collodion

[Collod. Sal. Co.]

	Metric	Old form
Salicylic Acid	11 Gm.	192½ gr.
Fluidextract of Cannabis	10 Gm.	175 gr.
Flexible Collodion, a sufficient quantity,		
To make	100 Gm.	4 oz. av.

Dissolve the salicylic acid in 75 Gm. [old form 3 oz. av.] of flexible collodion in a tared bottle. Add the fluidextract of cannabis and finally enough flexible collodion to make the product weigh 100 Gm. [old form 4 oz. av.].

COLLODIUM STYPTICUM. N. F. Styptic Collodion

(Replacing U. S. P. VIII)

[Collod. Stypt.]

	Metric	Old form
Tannic Acid	20 Gm.	350 gr.
Flexible Collodion	80 Gm.	3 oz. av. 87½ gr.
To make	100 Gm.	4 oz. av.

Add the tannic acid to the flexible collodion in a bottle and agitate the mixture until the tannic acid is dissolved.

COLLODIUM TIGLII. N. F. Croton Oil Collodion

[Collod. Tiglii]

	Metric	Old form
Croton Oil	10 Gm.	175 gr.
Flexible Collodion	90 Gm.	3 oz. av. 262½ gr.
To make	100 Gm.	4 oz. av.

Mix them.

CHAPTER XXV

OLEAGINOUS SOLUTIONS OR EXTERNAL APPLICATIONS

Linimenta *Liniments*

THESE are solutions or mixtures of various substances in oily or alcoholic liquids, intended for external application, and usually applied with friction and rubbing of the skin. There are *eight* liniments official in the U. S. P. IX and *nine* in the N. F. IV, of which *three* are made with a fixed oil as the vehicle, *ten* with alcohol as the principal vehicle, and *four* contain oil of turpentine. They are classified as follows:

Liniments of the U. S. P. IX

Name	Vehicle	Proportions	Process
Linimentum Ammoniæ	Oil	250 mils Ammonia Water; 750 mils Sesame Oil	Shake the Ammonia Water with the Oil until a uniform mixture is obtained
Calcis	Oil	Equal volumes Lime Water and Linseed Oil	Mix them by agitation in a bottle
Camphoræ	Oil	It yields from 19.5 to 20.5 per cent. of Camphor. 200 Gm. Camphor; 800 Gm. Cottonseed Oil	Heat the Oil in a bottle on a water bath, introduce the Camphor, in coarse powder, stopper, and, without further heating, agitate until the Camphor is dissolved
Belladonnæ	Alcohol	50 Gm. Camphor; Fluidextract of Belladonna Root, enough to make 1000 mils	Dissolve the Camphor in 800 mils of the Fluidextract and add enough of the latter to make 1000 mils
Chloroformi	Alcohol	300 mils Chloroform; 700 mils Soap Liniment	Mix them
Saponis	Alcohol	60 Gm. Granulated Soap; 45 Gm. Camphor; 10 mils Oil of Rosemary; 700 mils Alcohol; Water, enough to make 1000 mils	Dissolve the Camphor and Oil in the Alcohol, add the Soap, granulated or powdered, mix well and then add enough Water to make 1000 mils. Agitate until the Soap dissolves and filter after standing 24 hours
Saponis Mollis	Alcohol	650 Gm. Soft Soap; 20 mils Oil of Lavender; Alcohol, enough to make 1000 mils	Mix the Oil with 300 mils of Alcohol, dissolve the Soft Soap in this liquid, by agitation, and, after 24 hours, filter and add enough Alcohol to make 1000 mils
Terebinthinæ	Oil of Turpentine	650 Gm. Rosin Cerate; 350 Gm. Oil of Turpentine	Dissolve the melted Cerate in the Oil of Turpentine

Liniments of the N. F. IV

Title	Vehicle	Ingredients	Method of Preparation
Linimentum Aconiti et Chloroformi	Alcohol	45 mils Fluidextract of Aconite; 80 mils Alcohol; 125 mils Chloroform; 750 mils Soap Liniment	Mix them
Ammonii Iodidi	Alcohol	4 Gm. Iodine; 15 mils Oil of Rosemary; 15 mils Oil of Lavender; 32 Gm. Camphor; 110 mils Ammonia Water; Alcohol, enough to make 1000 mils	Dissolve the Iodine, the Oils and the Camphor in 750 mils of Alcohol; add the Ammonia Water and enough Alcohol to make 1000 mils and filter

Liniments of the N. F. IV—*Continued*

Title	Vehicle	Ingredients	Process
Linimentum Saponato-Camphoratum	Alcohol	10 Gm. Monohydrated Sodium Carbonate; 50 Gm. Stearic Acid; 100 mils Water; 25 Gm. Camphor; 3 mils Oil of Thyme; 6 mils Oil of Rosemary; 50 mils Ammonia Water; Alcohol, enough to make 1000 mils	Dissolve the Sodium Carbonate in the hot Water, add 200 mils of Alcohol and the Stearic Acid and warm until solution results. Then add the Oils and Camphor dissolved in 500 mils of Alcohol, then the Ammonia Water and enough Alcohol to make 1000 mils. Filter while hot
Saponis Mollis / Compositum	Alcohol	150 Gm. Soft Soap; 20 mils Oil of Cade; Alcohol, enough to make 1000 mils	Soften the Soap by heating it on a water bath. Mix it, without further heat, with 750 mils of Alcohol and when cold, add the Oil of Cade. Finally filter and add enough Alcohol to make 1000 mils
Sinapis Compositum	Alcohol	30 mils Volatile Oil of Mustard; 200 mils Fluidextract of Mezereum; 60 Gm. Camphor; 150 mils Castor Oil; Alcohol, enough to make 1000 mils	Dissolve the Camphor in the Alcohol, add the Fluidextract, the Oil of Mustard, the Castor Oil, and enough Alcohol to make 1000 mils
Tiglii	Alcohol	13 mils Croton Oil; 43 mils Oil of Cajuput; 44 mils Alcohol	Mix them
Opii Compositum	Oil of Turpentine	100 mils Tincture of Opium; 17.5 Gm. Camphor; 25 mils Oil of Peppermint; 250 mils Alcohol; 50 mils Fresh Egg Albumen; 350 mils Ammonia Water; 220 mils Oil of Turpentine	Mix the Albumen with the Ammonia Water and gradually add the Oil of Turpentine. Shake the mixture thoroughly, add the Camphor and Oil of Peppermint in the Alcohol, and finally the Tincture of Opium
Terebinthinæ Aceticum	Oil of Turpentine	400 mils Oil of Turpentine; 16 mils Oil of Lemon; 80 mils Acetic Acid; Hen's Egg and Rose Water, each, enough to make 1000 mils	Thoroughly mix the contents of two Fresh Eggs, and the Yolks of two others, with the Oil of Turpentine and the Oil of Lemon. Then incorporate the Acetic Acid and enough Rose Water to make 1000 mils
Tiglii Compositum	Oil of Turpentine	20 mils Croton Oil; 20 mils Oil of Sassafras; 20 mils Oil of Turpentine; 40 mils Olive Oil	Mix them

Unofficial Liniments

Title	Ingredients	Method of Preparation
Linimentum Aconiti. Br.	100 mils contains 0.2 Gm. of ether-soluble alkaloids of Aconite Root and 3 Gm. of Camphor; 500 Gm. Aconite Root, No. 40 powder; Camphor and Alcohol, each, a sufficient quantity	Percolate the Aconite Root with 90 per cent. Alcohol until exhausted. Reserve the first 750 mils of percolate, evaporate the remainder, dissolve the evaporated portion in the reserve and assay. Then add sufficient Camphor and Alcohol to produce a Liniment of the required standard
Camphoræ Ammoniatum. Br.	125 Gm. Camphor; 5 mils Oil of Lavender; 250 mils Strong Solution of Ammonia (32.5 per cent.); Alcohol, enough to make 1000 mils	Dissolve the Camphor and the Oil of Lavender in 600 mils of Alcohol, add the Strong Solution of Ammonia gradually and Alcohol to make 1000 mils and shake until a clear solution is formed
Hydrargyri. Br.	50 Gm. Ointment of Mercury; 40 mils Solution of Ammonia; 80 mils Liniment of Camphor	Add the Solution of Ammonia to the Liniment of Camphor and triturate the Ointment of Mercury with the mixture
Opii. Br.	500 mils Tincture of Opium; 500 mils Liniment of Soap	Mix, set aside for a few days, and filter
Potassii Iodidi cum Sapone. Br.	40 Gm. Curd Soap; 30 Gm. Potassium Iodide; 20 mils Glycerin; 2 mils Oil of Lemon; 200 mils Distilled Water	Dissolve the Soap, with the aid of a gentle heat, in the Glycerin and Water, restoring any Water lost through evaporation; add the solution to the powdered Potassium Iodide in a mortar and triturate until cold. set aside for an hour, and then incorporate the Oil of Lemon

LINIMENTUM AMMONIÆ. U. S. Ammonia Liniment

[Lin. Ammon. VOLATILE LINIMENT HARTSHORN LINIMENT]

	Metric	Old form
*Ammonia Water	250 mils	8 fl. oz.
Sesame Oil	750 mils	24 fl. oz.
To make	1000 mils	2 pints

Agitate the ammonia water with the sesame oil until a uniform mixture is obtained.

LINIMENTUM BELLADONNÆ. U. S. Belladonna Liniment

[Lin. Bellad.]

	Metric	Old form
*Camphor	50 Gm.	180 gr.
Fluidextract of Belladonna Root, a sufficient quantity,		
To make	1000 mils	8 fl. oz.

Dissolve the camphor in about 800 mils [old form 25½ fl. oz.] of the fluidextract, and then add enough of the latter to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly.

LINIMENTUM CALCIS. U. S. Lime Liniment

[Lin. Calc. CARRON OIL]

	Metric	Old form
*Solution of Calcium Hydroxide	500 mils	1 pint
Linseed Oil	500 mils	1 pint
To make	1000 mils	2 pints

Mix them by agitation.

LINIMENTUM CAMPHORÆ. U. S. Camphor Liniment

[Lin. Camph. CAMPHORATED OIL]

One hundred grammes of Liniment of Camphor yields not less than 19.5 Gm. nor more than 20.5 Gm. of camphor. This preparation is not intended for hypodermic use.

	Metric	Old form
*Camphor, in coarse powder	200 Gm.	2 oz. av.
Cottonseed Oil	800 Gm.	8 oz. av.
To make	1000 Gm.	10 oz. av.

Introduce the cottonseed oil into a suitable flask or bottle, heat it on a water bath, introduce the camphor and stopper the container securely. Dissolve the camphor by agitation without the further application of heat.

Assay.—Weigh 25 Gm. of Camphor Liniment into a tared 150-mil flask and connect this flask with a 500-mil distillation flask containing 275 mils of alcohol. Adjust the tube from the distillation flask so that it reaches to within 0.5 cm. of the bottom of the flask containing the Liniment and connect the latter flask with a condenser. Now heat both flasks on sand baths and regulate the temperature so that the alcohol vapors will pass rapidly through the Liniment without condensing. Receive the distillate in a flask graduated to 250 mils and continue the distillation until, at 25° C. (77° F.), the

distillate measures 250 mils. Fill a 200-mm. polariscope tube with the distillate and take the mean of four or more readings of the rotation, beginning at zero each time. The temperature correction for each degree is half a minute additive if above, subtractive if below 25° C. (77° F.). Place about 20 Gm. of the Camphor Liniment in an evaporating dish, 9 cm. in diameter, and cover it with an inverted funnel 8 cm. in diameter. Place the dish on wire gauze, 10 cm. above a Bunsen burner having a flame 4 cm. high. When the camphor has all sublimed, dissolve 0.5 Gm. of the Sublimate in sufficient alcohol to make exactly 25 mils at 25° C. (77° F.) and take the mean of four or more polariscope readings as before. The minutes of rotation of the distillate divided by the minutes of rotation of the control test just made, and this multiplied by 20, will give the number of grammes of camphor in 100 Gm. of Camphor Liniment.

N. F. Preparation.—Ceratum Camphoræ.

LINIMENTUM CHLOROFORMI. U. S. Chloroform Liniment

[Lin. Chlorof.]

	Metric	Old form
***Chloroform**	**300 mils**	9½ fl. oz.
Soap Liniment	**700 mils**	22½ fl. oz.
To make	**1000 mils**	2 pints

Mix them by agitation.

LINIMENTUM SAPONIS. U. S. Soap Liniment

[Lin. Sapon. Liquid Opodeldoc]

	Metric	Old form
***Soap,** dried and granulated or powdered	**60 Gm.**	2 oz. av.
Camphor, in small pieces	**45 Gm.**	1 oz. av. 220 gr.
Oil of Rosemary	**10 mils**	154 min.
Alcohol	**700 mils**	22½ fl. oz.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the camphor and the oil of rosemary in the alcohol, add the soap and sufficient water to make the product measure 1000 mils [old form 2 pints]. Agitate the mixture until the soap is dissolved, set it aside in a cool place for twenty-four hours, and then filter.

Only the best grade of Castile Soap should be used; soaps made from animal oils will cause gelatinization. If soap shavings from bar soap are used, dry thoroughly and then run through a mill or grater, if the U. S. P. process is to be followed.

U. S. P. Preparation.—Linimentum Chloroformi.
N. F. Preparation.—Linimentum Aconiti et Chloroformi.

LINIMENTUM SAPONIS MOLLIS. U. S. Liniment of Soft Soap

[Lin. Sapon. Moll. Tincture of Green Soap]

	Metric	Old form
***Soft Soap**	**650 Gm.**	21½ oz. av.
Oil of Lavender	**20 mils**	5 fl. dr.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the oil of lavender with 300 mils [old form 9½ fl. oz.] of alcohol, dissolve in this the soft soap by stirring or agitation, and set the solu-

tion aside for twenty-four hours. Then filter it through paper, adding sufficient alcohol to make the product measure 1000 mils [old form 2 pints].

LINIMENTUM TEREBINTHINÆ. U. S. Turpentine Liniment

[Lin. Terebinth. KENTISH'S OINTMENT]

	Metric	Old form
*Rosin Cerate	650 Gm.	13 oz. av.
Oil of Turpentine	350 Gm.	7 oz. av.
To make	1000 Gm.	20 oz. av.

Dissolve the rosin cerate, previously melted in a dish on a water bath, in the oil of turpentine, and mix them thoroughly.

LINIMENTUM ACONITI ET CHLOROFORMI. N. F. Liniment of Aconite and Chloroform

[Lin. Aconit. et Chlorof.]

	Metric	Old form
Fluidextract of Aconite	45 mils	1 fl. oz. 211 min.
Alcohol	80 mils	2 fl. oz. 269 min.
Chloroform	125 mils	4 fl. oz.
Soap Liniment	750 mils	24 fl. oz.
To make	1000 mils	2 pints

Mix them.

LINIMENTUM AMMONII IODIDI. N. F. Liniment of Ammonium Iodide

[Lin. Ammon. Iod.]

	Metric	Old form
Iodine	4 Gm.	58 gr.
Oil of Rosemary	15 mils	230 min.
Oil of Lavender	15 mils	230 min.
Camphor	32 Gm.	1 oz. av. 30 gr.
Ammonia Water	110 mils	3 fl. oz. 250 min.
Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the iodine, the oils, and the camphor in 750 mils [old form 24 fl. oz.] of alcohol, then add the ammonia water, and, finally, enough alcohol to make the product measure 1000 mils [old form 2 pints].

If a precipitate forms, filter the Liniment before dispensing it.

LINIMENTUM OPII COMPOSITUM. N. F. Compound Liniment of Opium

[Lin. Opii Co. CANADA LINIMENT]

	Metric	Old form
Tincture of Opium	100.0 mils	3 fl. oz. 96 min.
Camphor	17.5 mils	255 gr.
Oil of Peppermint	25.0 mils	384 min.
Alcohol	250.0 mils	8 fl. oz.
Fresh Egg Albumen	50.0 mils	1 fl. oz. 288 min.
Ammonia Water	350.0 mils	11 fl. oz. 96 min.
Oil of Turpentine	220.0 mils	7 fl. oz. 19 min.
To make about	1000 mils	2 pints

Mix the albumen with the ammonia water and gradually add the oil of turpentine. Shake it thoroughly and add the camphor and oil of peppermint previously dissolved in the alcohol, and finally the tincture of opium.

Shake it well before dispensing.

LINIMENTUM SAPONATO-CAMPHORATUM. N. F. Camphorated Soap Liniment

[Lin. Sapon.-Camph. OPODELDOC SOLID OPODELDOC]

	Metric	Old form
Monohydrated Sodium Carbonate	**10 Gm.**	146 gr.
Stearic Acid	**50 Gm.**	1 oz. av. 293 gr.
Water	**100 mils**	3 fl. oz. 96 min
Camphor, in fine powder	**25 Gm.**	365 gr.
Oil of Thyme	**3 mils**	46 min.
Oil of Rosemary	**6 mils**	92 min.
Ammonia Water	**50 mils**	1 fl. oz. 288 min.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the monohydrated sodium carbonate in the water with the aid of heat, add 200 mils [old form 6 fl. oz. 192 min.] of alcohol and the stearic acid and warm the mixture until effervescence has ceased and solution results. Add the oils and camphor dissolved in 500 mils [old form 1 pint] of alcohol, then the ammonia water and sufficient alcohol to make the product measure 1000 mils [old form 2 pints]. Finally filter the Liniment while hot. Pour the filtered liquid into dry, wide-mouthed bottles, stopper these and set them aside to cool.

LINIMENTUM SAPONIS MOLLIS COMPOSITUM. N. F. Compound Liniment of Soft Soap

[Lin. Sapon. Mol. Co. TINCTURA SAPONIS VIRIDIS COMPOSITA, N. F. III]

	Metric	Old form
Soft Soap	**150 Gm.**	5 oz. av. 3 gr.
Oil of Cade	**20 mils**	307 min.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Soften the soap by warming it in a dish on a water bath; remove it from the heat, mix it with 750 mils [old form 24 fl. oz.] of alcohol, and, when it has cooled, add the oil of cade. Then filter the liquid and wash the filter with sufficient alcohol to make the product measure 1000 mils [old form 2 pints].

LINIMENTUM SINAPIS COMPOSITUM. N. F. Compound Liniment of Mustard

[Lin. Sinap. Co.]

	Metric	Old form
Volatile Oil of Mustard	**30 mils**	461 min.
Fluidextract of Mezereum	**200 mils**	6 fl. oz. 192 min.
Camphor	**60 Gm.**	2 oz. av. 1 gr.
Castor Oil	**150 mils**	4 fl. oz. 384 min.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the camphor in 500 mils [old form 1 pint] of alcohol, add the fluidextract of mezereum, then the oil of mustard and castor oil, and sufficient alcohol to make the product measure 1000 mils [old form 2 pints]. Mix thoroughly.

LINIMENTUM TEREBINTHINÆ ACETICUM. N. F. Acetic Turpentine Liniment

[Lin. Terebinth. Acet. LINIMENTUM ALBUM STOKES' LINIMENT ST. JOHN LONG'S LINIMENT]

	Metric	Old form
Oil of Turpentine	400 mils	12 fl. oz. 384 min.
Oil of Lemon	16 mils	246 min.
Acetic Acid	80 mils	2 fl. oz. 269 min.
Hen's Egg,		
Rose Water, each, a sufficient quantity,		
To make	1000 mils	2 pints

Triturate the contents of two fresh eggs and the yolks of two others with the oil of turpentine and the oil of lemon in a mortar until they are thoroughly mixed. Then incorporate the acetic acid and sufficient rose water to make the product measure 1000 mils [old form 2 pints].

Shake the Liniment, whenever any of it is to be dispensed.

LINIMENTUM TIGLII. N. F. Liniment of Croton Oil

[Lin. Tiglii LINIMENTUM CROTONIS]

	Metric	Old form
Croton Oil	13 mils	1 fl. oz. 20 min.
Oil of Cajuput	43 mils	3 fl. oz. 210 min.
Alcohol	44 mils	3 fl. oz. 250 min.
To make	100 mils	8 fl. oz.

Mix them.

LINIMENTUM TIGLII COMPOSITUM. N. F. Compound Croton Oil Liniment

[Lin. Tiglii Co.]

	Metric	Old form
Croton Oil	20 mils	1 fl. oz. 288 min.
Oil of Sassafras	20 mils	1 fl. oz. 288 min.
Oil of Turpentine	20 mils	1 fl. oz. 288 min.
Olive Oil	40 mils	3 fl. oz. 96 min.
To make	100 mils	8 fl. oz.

Mix them.

Oleata *Oleates*

The official oleates are mainly liquid preparations made by dissolving alkaloids in oleic acid; however, the Oleate of Mercury, the only oleate retained in the U. S. P., is prepared by dissolving Mercuric Oxide in oleic acid so as to form a product of ointment-like consistence,

containing about 88 per cent. of Mercuric Oleate, and with an excess of oleic acid.

Four oleates of the U. S. P. VIII, which are solutions of alkaloids, were transferred to the N. F. IV. They are not assumed to be definite chemical compounds; the proportion of oleic acid is excessive, and they must be regarded as solutions of the medicating agent in oleic acid, the latter having special advantages as a basis for administering external remedies, being more readily absorbed than most of the fatty substances used in making ointments. *One* oleate is official in the U. S. P. IX and *five* in the N. F. IV.

Official Oleates

Title	Ingredients	Method of Preparation
Oleatum Aconitinæ, N. F.	2 Gm. Aconitine; 50 Gm. Oleic Acid; Olive Oil, enough to make 100 Gm.	Triturate the Aconitine in a mortar with the Oleic Acid, added slowly, until dissolved, and add enough Olive Oil to make 100 Gm.
Atropinæ, N. F.	2 Gm. Atropine; 2 mils Alcohol; 50 Gm. Oleic Acid; Olive Oil, enough to make 100 Gm.	Triturate the Atropine in a tared mortar with the Alcohol, add an equal volume of Oleic Acid, warm the mortar and stir until the Alcohol evaporates. Then add the remaining Oleic Acid, stir until the alkaloid dissolves and add enough Olive Oil to make 100 Gm.
Cocainæ, N. F.	5 Gm. Cocaine; 5 mils Alcohol; 50 Gm. Oleic Acid; Olive Oil, enough to make 100 Gm.	Prepare as directed for Oleatum Atropinæ
Hydrargyri, U. S. P.	25 Gm. Yellow Mercuric Oxide; 20 mils Alcohol; Oleic Acid, enough to make 100 Gm.	Mix the Mercuric Oxide with the Alcohol, in a tared dish, add 75 Gm. of Oleic Acid and warm at, not over, 50° C. (122° F.), with frequent stirring, until Alcohol is evaporated and solution results. Then add enough Oleic Acid to make 100 Gm.
Quininæ, N. F.	25 Gm. Quinine; 75 Gm. Oleic acid	Triturate the Quinine with a small quantity of the Oleic Acid, in a warm mortar. Then add the remaining Oleic Acid, warmed, and triturate until dissolved
Veratrinæ, N. F.	2 Gm. Veratrine; 50 Gm. Oleic Acid; Olive Oil, enough to make 100 Gm.	Triturate the Veratrine in a tared mortar with 5 mils of Olive Oil, warm the mortar, add the Oleic Acid and stir until the alkaloid dissolves. Then add enough Olive Oil to make 100 Gm.

Unofficial Oleate

Title	Ingredients	Method of Preparation
Oleatum Zinci, U. S. P. 1890	50 Gm. Zinc Oxide; 950 Gm. Oleic Acid	Incorporate the Zinc Oxide with the Oleic Acid contained in a porcelain dish, set aside for three hours, and then heat on a water bath, frequently stirring, until dissolved

OLEATUM HYDRARGYRI. U. S. Oleate of Mercury

[Oleat. Hydrarg.]

	Metric	Old form
***Yellow Mercuric Oxide**, in very fine powder.....	**25 Gm.**	1 oz. av.
Alcohol	**20 mils**	6¼ fl. dr.
Oleic Acid, a sufficient quantity,		
To make.....	**100 Gm.**	4 oz. av.

Mix the yellow mercuric oxide with the alcohol in a tared dish, add 75 Gm. [old form 2½ oz. av.] of oleic acid, warm the mixture to a temperature not exceeding 50° C. (122° F.), stir constantly for five minutes and then continue the heat, stirring frequently, until the alcohol is expelled and the mercuric oxide is dissolved. Now add sufficient oleic acid to make the product weigh 100 Gm. [old form 4 oz. av.] and mix thoroughly. Preserve Oleate of Mercury in tightly-closed containers protected from strong light and do not dispense it if globules of mercury are visible at the bottom of the container. In the preparation of this Oleate avoid all contact with metallic utensils.

U. S. P. Preparations.—Massa Hydrargyri, Unguentum Hydrargyri.

OLEATUM ACONITINÆ. N. F. Oleate of Aconitine

[Oleat. Aconitin.]

	Metric	Old form
Aconitine	**2 Gm.**	**35 gr.**
Oleic Acid	**50 Gm.**	**2 oz. av.**
Olive Oil, a sufficient quantity,		
To make	**100 Gm.**	**4 oz. av.**

Triturate the aconitine with a small portion of the oleic acid in a mortar, then incorporate the remainder of the oleic acid and stir the mixture frequently until the alkaloid is dissolved; finally add sufficient olive oil to make the product weigh 100 Gm. [old form 4 oz. av.].

CAUTION.—Oleate of Aconitine should never be applied with the unprotected hand or fingers; use a brush or small swab.

OLEATUM ATROPINÆ. N. F. Oleate of Atropine

(U. S. P. VIII)

[Oleat. Atrop.]

	Metric	Old form
Atropine	**2 Gm.**	**35 gr.**
Alcohol	**2 mils**	**35 min.**
Oleic Acid	**50 Gm.**	**2 oz. av.**
Olive Oil, a sufficient quantity,		
To make	**100 Gm.**	**4 oz. av.**

Triturate the atropine in a tared mortar with the alcohol, then add about an equal volume of the oleic acid, and, after warming the mortar, stir until the alcohol has evaporated. Now add the remainder of the oleic acid, and continue stirring until the atropine is dissolved. Finally add sufficient olive oil to make the product weigh 100 Gm. [old form 4 oz. av.].

OLEATUM COCAINÆ. N. F. Oleate of Cocaine

(U. S. P. VIII)

[Oleat. Cocain.]

	Metric	Old form
Cocaine	**5 Gm.**	**87½ gr.**
Alcohol	**5 mils**	**90 min.**
Oleic Acid	**50 Gm.**	**2 oz. av.**
Olive Oil, a sufficient quantity,		
To make	**100 Gm.**	**4 oz. av.**

Triturate the cocaine in a tared mortar with the alcohol, then add about an equal volume of the oleic acid, and, after warming the mortar, stir until the alcohol has evaporated. Now add the remainder of the oleic acid, and continue stirring until the cocaine is dissolved. Finally add sufficient olive oil to make the product weigh 100 Gm. [old form 4 oz. av.].

OLEATUM QUININÆ. N. F. Oleate of Quinine

(U. S. P. VIII)

[Oleat. Quin.]

	Metric	Old form
Quinine	**25 Gm.**	1 oz. av.
Oleic Acid	**75 Gm.**	3 oz. av.
To make	**100 Gm.**	4 oz. av.

Triturate the quinine in a warm mortar with a small quantity of the oleic acid to a smooth paste. Then add the remainder of the oleic acid, previously warmed, and stir frequently until the quinine is dissolved.

OLEATUM VERATRINÆ. N. F. Oleate of Veratrine

(U. S. P. VIII)

[Oleat. Veratrin.]

	Metric	Old form
Veratrine	**2 Gm.**	35 gr.
Oleic Acid	**50 Gm.**	2 oz. av.
Olive Oil, a sufficient quantity,		
To make	**100 Gm.**	4 oz. av.

Triturate the veratrine in a tared mortar with about 5 mils [old form 90 minims] of olive oil, and, after warming the mortar, add the oleic acid, and continue stirring until the veratrine is dissolved; finally add sufficient olive oil to make the product weigh 100 Gm. [old form 4 oz. av.].

Petroxolina *Petroxolins*

This class of preparations was represented in the Third Edition of the National Formulary by the two unmedicated forms, under the titles "Liquid and Solid Saponated Petrolatum." The N. F. IV has added *eighteen* titles, making a total of *twenty;* these are mostly made by the simple addition of a medicinal substance to either the Liquid or Solid vehicle. A new title has also been adopted, "Petroxolinum," and a synonym "Petrox" recognized. These preparations are intended for external application, and the value of liquid petroxolin depends upon its being an excellent solvent for many substances used externally, combined with its ready absorption through the skin.

Petroxolins of the N. F. IV

Title	Ingredients	Method of Preparation
Unmedicated Petroxolins		
Petroxolinum Liquidum	50 Gm. Light Liquid Petrolatum; 28 Gm. Oleic Acid; 2 Gm. Oil of Lavender; 5 Gm. Stronger Ammonia Water; Alcohol 15 Gm., to make 100 Gm.	Mix the Liquid Petrolatum and Oleic Acid in a flask, add the Alcohol, then the Stronger Ammonia Water and heat on a water bath with frequent agitation until clear. Finally add the Oil of Lavender
Spissum	35 Gm. White Wax; 20 Gm. Light Liquid Petrolatum; 32 Gm. Oleic Acid; 3 Gm. Oil of Lavender; 5 Gm. Alcohol; 5 Gm. Stronger Ammonia Water, to make 100 Gm.	Melt the White Wax on a water bath with the Liquid Petrolatum, add the Oleic Acid, transfer the mixture to a warm mortar, immediately add the mixed Alcohol and Stronger Ammonia Water and stir until cold. Finally add the Oil of Lavender
Medicated Petroxolins		
Petroxolinum Betanaphtholis	10 Gm. Betanaphthol; 90 Gm. Liquid Petroxolin	Dissolve by agitation. It must be freshly prepared
Cadini	25 Gm. Oil of Cade; 75 Gm. Liquid Petroxolin	Mix them
Chloroformi Camphoratum	25 Gm. Chloroform; 25 Gm. Camphor; 50 Gm. Liquid Petroxolin	Dissolve the Camphor in the Chloroform and add the Liquid Petroxolin
Creosoti	20 Gm. Creosote; 5 Gm. Oleic Acid; 75 Gm. Liquid Petroxolin	Mix them
Eucalyptolis	20 Gm. Eucalyptol; 80 Gm. Liquid Petroxolin	Mix them
Guaiacolis	20 Gm. Guaiacol; 5 Gm. Oleic Acid; 75 Gm. Liquid Petroxolin	Mix them
Hydrargyri	30 Gm. Mercury; 13 Gm. Hydrous Wool Fat; 2 Gm. Oleic Acid; 55 Gm. Solid Petroxolin	Triturate the Mercury with the mixed Wool Fat and Oleic Acid until extinguished, then add the Solid Petroxolin and mix
Iodi	10 Gm. Iodine; 40 Gm. Oleic Acid; 20 Gm. Alcohol; 23 Gm. Light Liquid Petrolatum; 2 Gm. Oil of Lavender; 5 Gm. Stronger Ammonia Water	Dissolve the powdered Iodine in the Alcohol and Oleic Acid by agitation, add the Oil of Lavender and Liquid Petrolatum, mix and then add the Stronger Ammonia Water, shaking it until a clear solution results
Iodi Dilutum	5 Gm. Iodine; 95 Gm. Liquid Petroxolin	Dissolve by agitation in a stoppered bottle
Iodoformi	3 Gm. Iodoform; 20 Gm. Acetone; 10 Gm. Oleic Acid; 3 Gm. Eucalyptol; 64 Gm. Liquid Petroxolin	Dissolve the Iodoform in the Acetone, add the other ingredients and mix thoroughly. It must be freshly prepared
Mentholis	17 Gm. Menthol; 83 Gm. Liquid Petroxolin	Dissolve by agitation
Methylis Salicylatis	20 Gm. Methyl Salicylate; 80 Gm. Liquid Petroxolin	Mix them
Phenolis	5 Gm. Phenol; 95 Gm. Liquid Petroxolin	Dissolve by agitation
Phenolis Camphoratum	12.5 Gm. Phenol; 37.5 Gm. Camphor; 50 Gm. Liquid Petroxolin	Mix the Camphor and Phenol and when liquefied add the Liquid Petroxolin and mix
Picis	25 Gm. Rectified Oil of Tar; 75 Gm. Liquid Petroxolin	Mix them
Sulphuratum	3 Gm. Sublimed Sulphur; 37 Gm. Linseed Oil; 30 Gm. Oleic Acid; Liquid Petroxolin, enough to make 100 Gm.	Dissolve the Sulphur in the Oil by heating in a tared flask on a sand bath, cool, add the Oleic Acid and enough Liquid Petrolatum to make 100 Gm. Warm slightly, if necessary, until clear
Sulphuratum Compositum	10 Gm. Sulphurated Petroxolin; 10 Gm. Oil of Cade; 0.3 Gm. Thymol; 3 Gm. Eucalyptol; 30 Gm. Oil of Turpentine; Liquid Petroxolin, enough to make 100 Gm.	Mix the Thymol and Eucalyptol, add the Oils; and, when in solution, add the Sulphurated Petroxolin and enough Liquid Petroxolin to make 100 Gm.
Terebinthinæ Laricis	20 Gm. Venice Turpentine; 80 Gm. Liquid Petroxolin	Mix them

PETROXOLINUM LIQUIDUM. N. F. Liquid Petroxolin

[Petrox. Liq. Petrolatum Saponatum Liquidum, N. F. III Liquid Petrox]

	Metric	Old form
Light Liquid Petrolatum	50 Gm.	2 oz. av.
Oleic Acid	28 Gm.	1 oz. av. 52 gr.
Oil of Lavender	2 Gm.	35 gr.
Stronger Ammonia Water	5 Gm.	87½ gr.
Alcohol	15 Gm.	262 gr.
To make	100 Gm.	4 oz. av.

Mix the liquid petrolatum and oleic acid in a flask, add the alcohol and then the stronger ammonia water, and warm the mixture on a water bath, with frequent agitation, until it becomes clear. Lastly add the oil of lavender and mix thoroughly.

Note.—Difficulty is sometimes experienced in obtaining a clear solution and this is usually remedied by the further addition of a few drops of oleic acid.

Official Description.—A yellowish-brown liquid, miscible with ether, chloroform, petroleum benzin or acetone and producing an emulsion-like mixture when added to twice its volume of water.

N. F. Preparation.—Used as a vehicle for the liquid petroxolins.

PETROXOLINUM SPISSUM. N. F. Solid Petroxolin

[Petrox. Spiss. Petrolatum Saponatum Spissum, N. F. III Solid Petrox]

	Metric	Old form
White Wax	35 Gm.	1 oz. av. 175 gr.
Light Liquid Petrolatum	20 Gm.	350 gr.
Oleic Acid	32 Gm.	1 oz. av. 122½ gr.
Oil of Lavender	3 Gm.	52 gr.
Alcohol	5 Gm.	87½ gr.
Stronger Ammonia Water	5 Gm.	87½ gr.
To make	100 Gm.	4 oz. av.

Melt the white wax with the liquid petrolatum on a water bath, add the oleic acid and transfer the mixture at once to a warm mortar; immediately add the mixed alcohol and stronger ammonia water and stir continuously until cool. Finally add the oil of lavender.

N. F. Preparation.—Used as a vehicle in the solid petroxolins.

PETROXOLINUM BETANAPHTHOLIS. N. F. Betanaphthol Petroxolin

[Petrox. Betanaphthol. Betanaphthol Petrox]

	Metric	Old form
Betanaphthol, in fine powder	10 Gm.	175 gr.
Liquid Petroxolin	90 Gm.	3 oz. av. 262½ gr.
To make	100 Gm.	4 oz. av.

Dissolve the betanaphthol in the liquid petroxolin by agitation.

This preparation should not be dispensed unless it has been recently prepared.

PETROXOLINUM CADINI. N. F. Cade Petroxolin

[Petrox. Cadin. CADE PETROX]

	Metric	Old form
Oil of Cade	**25 Gm.**	1 oz. av.
Liquid Petroxolin	**75 Gm.**	3 oz. av.
To make	**100 Gm.**	4 oz. av.

Mix them.

PETROXOLINUM CHLOROFORMI CAMPHORATUM. N. F.

Camphorated Chloroform Petroxolin

[Petrox. Chlorof. Camph. CAMPHOR AND CHLOROFORM PETROX]

	Metric	Old form
Chloroform	**25 Gm.**	1 oz. av.
Camphor	**25 Gm.**	1 oz. av.
Liquid Petroxolin	**50 Gm.**	2 oz. av.
To make	**100 Gm.**	4 oz. av.

Dissolve the camphor in the chloroform and add the liquid petroxolin.

PETROXOLINUM CREOSOTI. N. F. Creosote Petroxolin

[Petrox. Creosot. CREOSOTE PETROX]

	Metric	Old form
Creosote	**20 Gm.**	350 gr.
Oleic Acid	**5 Gm.**	87½ gr.
Liquid Petroxolin	**75 Gm.**	3 oz. av.
To make	**100 Gm.**	4 oz. av.

Mix them.

PETROXOLINUM EUCALYPTOLIS. N. F. Eucalyptol Petroxolin

[Petrox. Eucalyptol. EUCALYPTOL PETROX]

	Metric	Old form
Eucalyptol	**20 Gm.**	350 gr.
Liquid Petroxolin	**80 Gm.**	3 oz. av. 87½ gr.
To make	**100 Gm.**	4 oz. av.

Mix them.

PETROXOLINUM GUAIACOLIS. N. F. Guaiacol Petroxolin

[Petrox. Guaiacol. GUAIACOL PETROX]

	Metric	Old form
Guaiacol	**20 Gm.**	350 gr.
Oleic Acid	**5 Gm.**	87½ gr.
Liquid Petroxolin	**75 Gm.**	3 oz. av.
To make	**100 Gm.**	4 oz. av.

Mix them.

PETROXOLINUM HYDRARGYRI. N. F. Mercury Petroxolin

[Petrox. Hydrarg. MERCURY PETROX]

	Metric	Old form
Mercury	30 Gm.	1 oz.av. 87½ gr.
Hydrous Wool Fat	13 Gm.	227½ gr.
Oleic Acid	2 Gm.	35 gr.
Solid Petroxolin	55 Gm.	2 oz.av. 87½ gr.
To make	100 Gm.	4 oz. av.

Triturate the mercury with the mixture of hydrous wool fat and oleic acid until it is distributed and globules are no longer visible when examined with a lens magnifying ten diameters; then add the solid petroxolin and mix thoroughly.

PETROXOLINUM IODI. N. F. Iodine Petroxolin

[Petrox. Iod. IODINE PETROX, 10 PER CENT.]

	Metric	Old form
Iodine	10 Gm.	175 gr.
Oleic Acid	40 Gm.	1 oz.av.262 gr.
Alcohol	20 Gm.	350 gr.
Light Liquid Petrolatum	23 Gm.	402 gr.
Oil of Lavender	2 Gm.	35 gr.
Stronger Ammonia Water	5 Gm.	87½ gr.
To make	100 Gm.	4 oz. av.

Reduce the iodine to a coarse powder by trituration in a glass mortar, transfer it to a suitable flask with the aid of the alcohol, add the oleic acid and agitate the contents of the flask until the iodine is dissolved. Then add the oil of lavender and the liquid petrolatum, mix the liquids, and finally introduce the stronger ammonia water and shake the mixture until a clear solution results.

PETROXOLINUM IODI DILUTUM. N. F. Diluted Iodine Petroxolin

[Petrox. Iod. Dil. IODINE PETROX, 5 PER CENT.]

	Metric	Old form
Iodine, in coarse powder	5 Gm.	87½ gr.
Liquid Petroxolin	95 Gm.	3 oz. av. 350 gr.
To make	100 Gm.	4 oz. av.

Dissolve the iodine by agitation with the liquid petroxolin in a stoppered bottle.

PETROXOLINUM IODOFORMI. N. F. Iodoform Petroxolin

[Petrox. Iodoform. IODOFORM PETROX]

	Metric	Old form
Iodoform	3 Gm.	52½ gr.
Acetone	20 Gm.	350 gr.
Oleic Acid	10 Gm.	175 gr.
Eucalyptol	3 Gm.	52½ gr.
Liquid Petroxolin	64 Gm.	2 oz. av. 245 gr.
To make	100 Gm.	4 oz. av.

Dissolve the iodoform in the acetone, add the eucalyptol, the oleic acid and the liquid petroxolin, and mix the ingredients thoroughly.

This preparation should not be dispensed unless it has been recently prepared.

PETROXOLINUM MENTHOLIS. N. F. Menthol Petroxolin

[Petrox. Menthol. MENTHOL PETROX]

	Metric	Old form
Menthol	**17 Gm.**	297 gr.
Liquid Petroxolin	**83 Gm.**	3 oz. av. 140 gr.
To make	**100 Gm.**	4 oz. av.

Dissolve the menthol in the liquid petroxolin by agitation.

PETROXOLINUM METHYLIS SALICYLATIS. N. F. Methyl Salicylate Petroxolin

[Petrox. Methyl. Sal. METHYL SALICYLATE PETROX]

	Metric	Old form
Methyl Salicylate	**20 Gm.**	350 gr.
Liquid Petroxolin	**80 Gm.**	3 oz. av. 87½ gr.
To make	**100 Gm.**	4 oz. av.

Mix them.

PETROXOLINUM PHENOLIS. N. F. Phenol Petroxolin

[Petrox. Phenol. PHENOL PETROX]

	Metric	Old form
Phenol	**5 Gm.**	87½ gr.
Liquid Petroxolin	**95 Gm.**	3 oz. av. 350 gr.
To make	**100 Gm.**	4 oz. av.

Dissolve the phenol in the liquid petroxolin by agitation.

PETROXOLINUM PHENOLIS CAMPHORATUM. N. F. Camphorated Phenol Petroxolin

[Petrox. Phenol. Camph. CAMPHORATED PHENOL PETROX]

	Metric	Old form
Phenol	**12.5 Gm.**	219 gr.
Camphor, in powder	**37.5 Gm.**	1 oz. av. 219 gr.
Liquid Petroxolin	**50.0 Gm.**	2 oz. av.
To make	**100 Gm.**	4 oz. av.

Mix the camphor and phenol, and when the mixture has liquefied add the liquid petroxolin, and mix them thoroughly.

PETROXOLINUM PICIS. N. F. Tar Petroxolin

[Petrox. Pic. TAR PETROX]

	Metric	Old form
Rectified Oil of Tar	**25 Gm.**	1 oz. av.
Liquid Petroxolin	**75 Gm.**	3 oz. av.
To make	**100 Gm.**	4 oz. av.

Mix them.

PETROXOLINUM SULPHURATUM. N. F. Sulphurated Petroxolin

[Petrox. Sulphur. SULPHURATED PETROX]

	Metric	Old form
Sublimed Sulphur	**3 Gm.**	52½ gr.
Linseed Oil	**37 Gm.**	1 oz. 210 gr.
Oleic Acid	**30 Gm.**	1 oz. av. 87½ gr.
Liquid Petroxolin, a sufficient quantity,		
To make	**100 Gm.**	4 oz. av.

Heat the sublimed sulphur and linseed oil in a tared flask, on a sand

bath, until the sulphur is dissolved, then allow the mixture to cool, add the oleic acid, and sufficient liquid petroxolin to make the product weigh 100 Gm. [old form 4 oz. av.]. Warm the mixture slightly, if necessary, to obtain a clear liquid.

N. F. Preparation.—Petroxolinum Sulphuratum Compositum.

PETROXOLINUM SULPHURATUM COMPOSITUM. N. F. **Compound Sulphurated Petroxolin**

[**Petrox. Sulphur. Co.** COMPOUND SULPHURATED PETROX]

	Metric	Old form
Sulphurated Petroxolin	**10.0 Gm.**	175 gr.
Oil of Cade	**10.0 Gm.**	175 gr.
Thymol	**0.3 Gm.**	5 gr.
Eucalyptol	**3.0 Gm.**	52½ gr.
Oil of Turpentine	**30.0 Gm.**	1 oz. av. 87½ gr.
Liquid Petroxolin, a sufficient quantity,		
To make	**100 Gm.**	4 oz. av.

Mix the thymol and eucalyptol, and the oils, and when in solution add the sulphurated petroxolin, and finally sufficient liquid petroxolin to make the product weigh 100 Gm. [old form 4 oz. av.].

PETROXOLINUM TEREBINTHINÆ LARICIS. N. F. **Venice Turpentine Petroxolin**

[**Petrox. Terebinth. Laric.** VENICE TURPENTINE PETROX]

	Metric	Old form
Venice Turpentine	**20 Gm.**	350 gr.
Liquid Petroxolin	**80 Gm.**	3 oz. av. 87 gr.
To make	**100 Gm.**	4 oz. av.

Mix them.

Nebulæ *Sprays*

Preparations of this class were recognized for the first time in the National Formulary IV. They consist of liquids intended for spraying from an atomizer or nebulizer and may be aqueous or oily in character. The N. F. IV has introduced *five* sprays, all of them prepared with an oily vehicle, *i.e.*, Light Liquid Petrolatum.

Sprays of the N. F. IV

Title	Ingredients	Method of Preparation
Nebula Aromatica	0.2 Gm. Phenol; 0.2 Gm. Menthol; 0.1 Gm. Thymol; 0.3 Gm. Camphor; 0.3 Gm. Benzoic Acid; 0.2 mil Eucalyptol; 0.2 mil Oil of Cinnamon; 0.2 mil Oil of Clove; 0.5 mil Methyl Salicylate; Light Liquid Petrolatum, enough to make 100 mils	Mix the Phenol, Menthol, Thymol and Camphor in a flask and warm gently until liquefied. Then add the other ingredients and filter
Eucalyptolis	5 mils Eucalyptol; 95 mils Light Liquid Petrolatum	Mix them
Mentholis	2 Gm. Menthol; Light Liquid Petrolatum, enough to make 100 mils	Dissolve the Menthol in the Liquid Petrolatum, warmed to 70° C. (158° F.) and filter
Mentholis Composita	1 Gm. Menthol; 1 Gm. Camphor; 0.5 mil Methyl Salicylate; 0.2 mil Eucalyptol; 0.2 mil Oil of Cinnamon; Light Liquid Petrolatum, enough to make 100 mils	Triturate the Menthol, Camphor, Eucalyptol, Methyl Salicylate and Oil together in a dry mortar, add 75 mils of Liquid Petrolatum and, when dissolved, enough Liquid Petrolatum to make 100 mils
Thymolis	1 Gm. Thymol; Light Liquid Petrolatum, enough to make 100 mils	Dissolve by agitation

NEBULA AROMATICA. N. F. Aromatic Oil Spray

[Nebul. Arom. AROMATOL]

	Metric	Old form
Phenol	0.2 Gm.	29 gr.
Menthol	0.2 Gm.	29 gr.
Thymol	0.1 Gm.	15 gr.
Camphor	0.3 Gm.	44 gr.
Benzoic Acid	0.3 Gm.	44 gr.
Eucalyptol	0.2 mil	31 min.
Oil of Cinnamon	0.2 mil	31 min.
Oil of Clove	0.2 mil	31 min.
Methyl Salicylate	0.5 mil	77 min.
Light Liquid Petrolatum, a sufficient quantity,		
To make	100 mils	2 pints

Mix the phenol, menthol, thymol and camphor in a flask and warm on a water bath until liquefied, then add the aromatic oils, eucalyptol, methyl salicylate, and benzoic acid and thoroughly mix with sufficient light liquid petrolatum to make the product measure 100 mils [old form 2 pints]. Filter if necessary.

NEBULA EUCALYPTOLIS. N. F. Eucalyptol Spray

[Nebul. Eucalyptol.]

	Metric	Old form
Eucalyptol	5 mils	1 fl. oz. 288 min.
Light Liquid Petrolatum	95 mils	30 fl. oz. 192 min.
To make	100 mils	2 pints

Mix them.

NEBULA MENTHOLIS. N. F. Menthol Spray

[Nebul. Menthol.]

	Metric	Old form
Menthol	2 Gm.	292 gr.
Light Liquid Petrolatum, a sufficient quantity,		
To make	100 mils	2 pints

Dissolve the menthol in the light liquid petrolatum which has been warmed to about 70° C. (158° F.), and filter if necessary.

NEBULA MENTHOLIS COMPOSITA. N. F. Compound Menthol Spray

[Nebul. Menthol. Co.]

	Metric	Old form
Menthol	1.0 Gm.	146 gr.
Camphor	1.0 Gm.	146 gr.
Methyl Salicylate	0.5 mil	77 min.
Eucalyptol	0.2 mil	31 min.
Oil of Cinnamon	0.2 mil	31 min.
Light Liquid Petrolatum, a sufficient quantity,		
To make	100 mils	2 pints

Triturate the menthol, camphor, eucalyptol, methyl salicylate and oil together in a dry mortar, add 75 mils [old form 24 fl. oz.] of light liquid petrolatum and continue trituration until solution is effected. Finally add sufficient light liquid petrolatum to make the product measure 100 mils [old form 2 pints] and filter if necessary.

NEBULA THYMOLIS. N. F. Thymol Spray
[Nebul. Thymol.]

	Metric	Old form
Thymol	1 Gm.	146 gr.
Light Liquid Petrolatum, a sufficient quantity,		
To make	100 mils	2 pints

Dissolve the thymol in the light liquid petrolatum.

Medicated Oils

Three preparations of the National Formulary belong to this class. They consist in two instances of a bland, fixed oil, to which an active medicinal substance has been added, and in the third preparation, of an active oil, castor oil, which is rendered palatable by the addition of aromatics.

OLEUM PHENOLATUM. N. F. Phenolated Oil
[Ol. Phenol. Oleum Carbolatum, N. F. III Carbolized Oil]

	Metric	Old form
Phenol	5 Gm.	87½ gr.
Olive Oil	95 Gm.	3 oz. av. 350 gr.
To make	100 Gm.	4 oz. av.

Melt the phenol with a gentle heat, and mix it with the olive oil.

OLEUM PHOSPHORATUM. N. F. Phosphorated Oil
[Ol. Phosphorat.]

	Metric	Old form
Phosphorus	1 Gm.	17½ gr.
Expressed Oil of Almond,		
Ether, each, a sufficient quantity,		
To make	100 Gm.	4 oz. av.

Pour a sufficient quantity of expressed oil of almond into a flask, heat it on a sand bath to 250° C. (482° F.) and keep it at that temperature for fifteen minutes. Then allow it to cool, and filter it. Introduce 90 Gm. [old form 3 oz. av. 262 grains] of the filtered oil together with the phosphorus, previously well dried, into a dry, tared bottle of about 120 mils [old form 4 fl. oz.] capacity, insert the stopper and heat the bottle in a water bath until the phosphorus melts. Then agitate it until the phosphorus is dissolved, allow the oil to cool before opening the bottle, add enough ether to make the mixture weigh 100 Gm. [old form 4 oz. av.] and agitate it again. Lastly, transfer the solution to small, glass-stoppered bottles, which should be completely filled and kept in a cool, dark place.

A clear, yellowish liquid, having the odor of phosphorus and of ether, and free from undissolved particles.

Average dose.—1 minim (0.05 mil).

OLEUM RICINI AROMATICUM. N. F. Aromatic Castor Oil
[Ol. Ricin. Arom.]

	Metric	Old form
Benzosulphinide	0.5 Gm.	7 gr.
Oil of Cinnamon	3.0 mils	46 min.
Oil of Clove	1.0 mil	15 min.
Vanillin	1.0 Gm.	15 gr.
Coumarin	0.1 Gm.	1½ gr.
Alcohol	30.0 mils	461 min.
Castor Oil, a sufficient quantity,		
To make	1000 mils	2 pints

Dissolve the volatile oils and the solids in the alcohol, add the castor oil and mix thoroughly.

Average dose.—4 fluidrachms (15 mils).

QUESTIONS ON ETHEREAL AND OLEAGINOUS SOLUTIONS OR THOSE FOR EXTERNAL APPLICATION

What are collodions, and how are they used? (See page 427.)
How many are official, and what are their names? State if in U. S. P. or N. F.
Give the formula and method for preparing collodion.
What is the Latin title for cantharidal collodion? What are the synonyms?
Give its formula and the details of preparation.
What is flexible collodion?
Give its formula and the details of preparation.
What per cent. of iodine is present in iodine collodion?
Name the ingredients in compound salicylic collodion.
What is styptic collodion?
Give its formula and the details of preparation.
Name the per cent. of croton oil in croton oil collodion.
What are liniments? (See page 430.)
How many are official in the U. S. P.? How many in the N. F.?
What substances are used as the bases for these liniments?
How is ammonia liniment made?
What are its popular names or synonyms?
Give the formula and details for making belladonna liniment. Lime liniment. What is this sometimes called?
How is camphor liniment prepared? What is it commonly called? Describe the assay.
How much chloroform is present in chloroform liniment?
What kind of soap should be used in soap liniment? How is this liniment made?
What is a common synonym?
What is the Latin name of liniment of soft soap?
What is a common synonym?
How is it made?
Give the formula and mode of making turpentine liniment.
Name the ingredients in liniment of aconite and chloroform.
How is Canada liniment made and what are its Latin and English titles?
How does camphorated soap liniment differ from soap liniment? What is its synonym?
Name the ingredients in compound liniment of mustard.
Give the method for preparing acetic turpentine liniment. What are its synonyms?
What are official oleates?
How many are official in the U. S. P.? How many in the N. F.? What are their names?
What advantage are they supposed to possess over the fatty substances that are commonly used in ointments?
Give the formula and mode of making oleate of aconitine, oleate of atropine, oleate of cocaine, oleate of mercury, oleate of quinine, and oleate of veratrine.
What are petroxolins? How many are recognized in the N. F.?
Why are they of value for external application?
How is liquid petroxolin made? Solid petroxolin?
Name the other official petroxolins and the percentage of active ingredients in each.
What are sprays or nebulæ?
How many are recognized in the N. F. ? Name them.
What liquid is used in the official sprays as the vehicle?
Name the medicated oils official in the N. F.
What per cent. of phenol is present in phenolated oil?
How is phosphorated oil made? How much phosphorus is present?
Name the aromatics used in aromatic castor oil.

CHAPTER XXVI

AQUEOUS LIQUIDS MADE BY PERCOLATION OR MACERATION

Infusa *Infusions*

INFUSIONS are liquid preparations made by treating vegetable substances with either hot or cold water. *The drug is not subjected to the boiling process,* although it is common to pour boiling water over it; the mixture is allowed to stand in a closed vessel until cold. While the use of hot water has the advantage of saving time in some cases, it is often objectionable because the *inert* principles in the drug are dissolved by the hot water, and as the infusion cools, they are precipitated in such a very finely divided condition that they cannot be readily separated by colation or filtration. Cold water should be selected as the menstruum when the drug contains a valuable volatile principle, when the active agent is injured by heat, or when the desirable principles are readily soluble in water of ordinary temperature. The time required to make the infusion must also be considered, for in warm weather it is quite possible for an infusion to ferment or decompose before it is finished.

Pure water should be used in making infusions, and they should not be made in large quantities unless demanded for immediate use, as, without special precautions to preserve them, they soon decompose.

Of the inert principles found in plants, starch is extracted by hot water and albumen by cold water, while gum, sugar, and extractive are dissolved by both.

In making infusions the drug is usually coarsely comminuted, sliced, or bruised. Fine powders should be avoided whenever possible, because it is difficult to separate the fine particles from the infusion; and if percolation is resorted to, so much time is consumed in the operation, owing to the swelling of the powder, that decomposition may set in before the preparation is finished. The number of infusions official in the U. S. P. IX is *two,* the number in the N. F. IV is *five.* Infusions are usually made in four ways: 1. By maceration. 2. By digestion. 3. By percolation. 4. By diluting fluidextracts.

1. **By Maceration.**—This is the process which is most frequently used. The general formula of the U. S. Pharmacopœia, which is here appended, furnishes a model.

General Official Formula for Infusions

Infusions must be *freshly made from the drugs,* and, when the strength of Infusions is not otherwise directed, they are to be prepared by the following general formula:

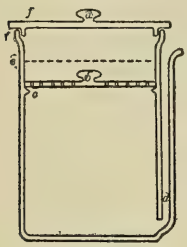
	Metric	Old form
***The Drug,** coarsely comminuted, fifty grammes..	**50 Gm.**	365 gr.
Water, a sufficient quantity,		
To make	**1000 mils**	1 pint

Introduce the substance into a suitable vessel provided with a cover, pour upon it 1000 mils [old form 1 pint] of boiling water, cover the vessel tightly, and allow it to stand for half an hour. Then strain with expression, and pass enough water through the strainer to make the Infusion measure 1000 mils [old form 1 pint]. If the activity of the Infusion is affected by heat, cold water only should be used.

Caution.—The strength of Infusions of potent or very active drugs should be specially directed by the physician.

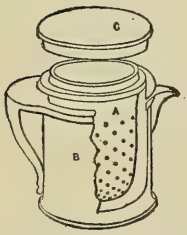
It will be found most convenient to provide special apparatus for making infusions by maceration. One of the oldest forms is known as *Alsop's Infusion Jar*. This presents a very neat and effectual method of making the hot infusions. It consists of an earthen-ware mug, represented in Fig. 430, with a spout, *d*, proceeding from the bottom, and placed closely to the side of the vessel to prevent fracture; a perforated plate or diaphragm, *b*, supported on a ledge, *c*, at about one-quarter or one-third of the height of the vessel from the top; and a lid, *a*, which may be fastened on by a string through holes *ff*. The material to be submitted to infusion is placed on the perforated plate, and the hot water poured in so as to cover it, the vessel having been previously warmed, so as not to chill the liquid. As the water becomes impregnated, it acquires an increased specific gravity, and sinks to the bottom, its place being supplied by the unsaturated portion; and this circulation goes on until the whole of the soluble matter is extracted. In order to maintain a due warmth, the vessel may be placed upon a stove, or upon an iron plate near the fire. The advantage of the process is that the material is subjected to the solvent power of the least impregnated portion of the menstruum. In order that the vessel may be adapted for the preparation of different quantities of infusions, it would be an advantage to have ledges arranged within, at different heights, so that the diaphragm may be supported at any desired point. The surface of

Fig. 430



Alsop's infusion jar

Fig. 431



Squire's infusion mug

Fig. 432

Infusion pitcher

Fig. 433

Infusion mug (home-made)

the liquid, *e*, should, of course, always be above the medicinal substance. Tinned iron or metallic vessels are unsuited for infusions; they are particularly objectionable when the drug used for making the preparation contains tannin, gallic acid, or an astringent substance. The liability of iron vessels to rust constitutes another objection.

Squire's Infusion Mug differs from the preceding in having a colander of queen's-ware, which is closely covered with a lid, and descends into the jar so as to form a diaphragm for the support of the substance to be infused. It has the advantage that the material, after having been exhausted, may be lifted out without disturbing the infusion. Fig. 431 shows the mug. It is made of queen's-ware, of the capacity of one pint, B; into it a thimble-shaped colander, A, descends, supported on the rim of the mug by a projecting ledge, with a carefully fitted cover, C, which closes the whole. The substance to be submitted to infusion is introduced into the colander either before or after it has been fitted to the mug; the water, hot or cold, as the case may be, is then poured in so as to fill the lower vessel and cover the materials in the upper; and, the cover having been applied, the vessel is set aside for the length of time required. The colander is then to be lifted out, and the infusion, without having to strain it, is ready for use.

Fig. 432 represents an earthen-ware infusion pitcher, which may be used for making a gallon of infusion; it is useful where there is a large demand. Its principle of action is similar to that of Squire's infusion mug. A still better and cheaper apparatus may be made by the pharmacist himself, by selecting a queen's-ware or porcelain tea- or coffee-pot, A, as in Fig. 433, and if a hole is bored with the broken end of a small file through the top, close to the handle, a copper wire may be passed through the hole and around the handle, and made to terminate in a hook. The material to be infused is loosely tied up in a square piece of cheese cloth (coarse, thin muslin) and suspended from the hook; the hot water soon penetrates all parts of the drug and dissolves out the soluble principles by circulatory displacement. This method has the great advantage that no further straining is needed, as the bag retains the solid undissolved portion; the bag may be pressed and the contents then thrown away.

Official Infusions made by Maceration

Title	Ingredients	Method of Preparation, Use, and Dose
Infusum Digitalis, U.S.P.	15 Gm. Digitalis; 150 mils Cinnamon Water; 500 mils Boiling Water; Cold Water to make 1000 mils	Pour 500 mils of Boiling Water upon the Digitalis and macerate in a closed vessel for 1 hour. Then strain, add the Cinnamon Water and enough Water to make 1000 mils. Diuretic, cardiac stimulant, f ʒ i (4 mils)
Sennæ Compositum, U. S. P.	60 Gm. Senna; 120 Gm. Manna; 120 Gm. Magnesium Sulphate; 20 Gm. Fennel; 800 mils Boiling Water; Cold Water to make 1000 mils	Pour 800 mils of Boiling Water upon the Senna, Manna and Fennel, and macerate, in a closed vessel, for 30 minutes. Then strain, dissolve the Magnesium Sulphate in the infusion, and add enough Water to make 1000 mils. Purgative, f ʒ iv (120 mils)
Brayeræ, N F.	60 Gm. Brayera; Boiling Water, 1000 mils	Pour the Boiling Water upon the drug and allow it to stand until cold. Dispense without straining, f ʒ viii (250 mils)
Rosæ Compositum, N. F.	13 Gm. Red Rose; 9 mils Diluted Sulphuric Acid; 40 Gm. Sugar; Boiling Water, 1000 mils	Pour the Boiling Water upon the drug, add the Acid, and macerate in a closed vessel during 1 hour. Then dissolve the Sugar in the liquid and strain. f ʒ iii (100 mils)

2. **By Digestion.**—The process of *digestion* consists in subjecting the substance to the continued action of moderate heat below the boiling temperature. In making infusions, digestion is often very useful, although it may not be directed in the formula. It generally suffices to place the infusion vessel (see Fig. 433) upon a moderately hot portion of the stove plate, or upon the floor near the stove or source of heat.

3. **By Percolation.**—This method of making infusions is by far the most satisfactory, and should be used whenever possible. It should be selected when the desirable principles are easily dissolved in water, and when the amount of menstruum is amply sufficient to exhaust the drug thoroughly. Percolation presents the advantages of furnishing a finished preparation, straining being unnecessary. Again, precipitation from the deposition of inert principles after the infusion has been strained, due to the principles being soluble in hot water but insoluble in cold water, is avoided. The chief drawback to the adoption of percolation in making infusions is the length of time it takes to exhaust the drug with water. Infusions are generally extemporaneous preparations, and they are frequently desired quickly; hence the process of maceration is often selected in preference.

Official Infusion made by Percolation

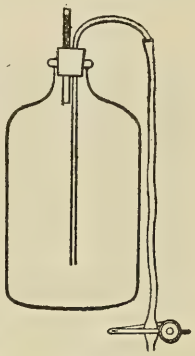
Title	Ingredients	Method of Preparation and Dose
Infusum Cinchonæ, N. F.	60 Gm. Cinchona, in No. 40 powder; 10 mils Aromatic Sulphuric Acid; Water, enough to make 1000 mils	Mix the Acid with 500 mils of Water and percolate the drug first with this mixture and then with enough Water to make 1000 mils. f ʒ xii (50 mils)
Gentianæ Compositum, N. F.	30 Gm. Gentian; 8 Gm. Coriander; 8 Gm. Bitter Orange Peel, all in No. 40 powder; Diluted Alcohol and Water, each, enough to make 1000 mils	Moisten the mixed drugs and percolate with Diluted Alcohol until the percolate measures 250 mils. Then add enough Water to make 1000 mils. f ʒ iv (15 mils)
Pruni Virginianæ, N. F.	40 Gm. Wild Cherry, in No. 20 powder; 50 mils Glycerin; Water, enough to make 1000 mils	Macerate the drug in a percolator, with 900 mils of Cold Water for 3 hours. Then percolate into the Glycerin and, after pressing down the drug, pour on enough more water to make the percolate measure 1000 mils. Mix well. Tonic, f ʒ ii (60 mils)

Preservation of Infusions.—The difficulty in preserving infusions arises from the decomposition of the principles which are extracted by water and retained in the preparation. If sufficient alcohol is added to prevent decomposition, the therapeutic action of the infusion is usually interfered with, owing to the comparatively large proportion of spirit contained in the dose. Alcohol is successfully used in preparations like infusion of gentian, orange peel, etc., or simple tonics. If an antiseptic, like boric acid, salicylic acid, sodium benzoate, or phenol is used, the same objection exists—the interference due to the therapeutic action of the antiseptic.

It has been proved that infusions may be preserved for a long time if they are protected from the microscopic organisms which float in the air (see chapter on Sterilization). A simple method is to gradually heat the infusion, contained in a bottle, to the boiling point in order to destroy any organisms that may be present, and then to transfer it at once, under proper precautions, to small bottles, which have been sterilized, filling them to the brim; the sterilized stoppers are then forced in

and tied over, and the stoppers, lip, and neck of each bottle dipped into hot paraffin or sealing wax. A useful modification of Almen's method consists in heating the infusion to the boiling point in a bottle, on a water bath. The rubber stopper of the bottle is perforated so as to admit a long bent tube and a short tube; the short tube is loosely filled with cotton, the long limb of the bent tube is passed through the cork, and a rubber tube with a pinchcock attached, as shown in Fig. 434. The cotton permits the admission of air into the bottle, but excludes organisms, spores, and dust. The infusion may be drawn from the bottle as wanted by the rubber tube and syphon, the flow being controlled by the pinchcock.

FIG. 434



Infusion bottle

4. Infusions from Fluidextracts.—The habit of making infusions from concentrated alcoholic tinctures or fluidextracts is improper and unjustifiable, except in those few cases in which the active and desirable principles of the drug are equally soluble in alcohol and in water, or in the menstrua used for both fluidextract and infusion. This is well illustrated in those preparations in which the activity of the drug is due to resinous bodies. Alcoholic menstrua here are necessary to dissolve the resins, and if such a fluidextract is added to water, precipitation takes place and the filtered infusion is worthless. If the precipitate is inert or does not carry down with it any portion of the active principle, and is readily separated, the only objection to the infusion is the presence of the alcohol, which may or may not seriously interfere with the therapeutic action, according as the quantity present is large or small. The saving in time and labor by making infusions in this way is the cause of the frequent employment of this method, but it should never be used if the therapeutic action of the drug is weakened thereby. The substitution of a fluidextract infusion in a prescription for one directed to be made by an official process is very reprehensible.

The British Pharmacopœia (1898) introduced concentrated infusions made by percolation, usually with 20 per cent. alcohol, but they provoked some criticism on account of their instability through precipitation and have been omitted from the 1914 edition.

INFUSUM DIGITALIS. U. S. **Infusion of Digitalis**
[Inf. Digit.]

	Metric	Old form
***Digitalis**, bruised	**15 Gm.**	½ oz. av.
Cinnamon Water	**150 mils**	5 fl. oz.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Pour 500 mils [old form 1 pint] of boiling water upon the digitalis, contained in a suitable vessel, and allow it to macerate for one hour. Then strain, add the cinnamon water to the strained liquid, and pass enough water through the residue on the strainer to make the product measure 1000 mils [old form 2 pints]. Mix well.

Infusion of Digitalis must be freshly prepared from the leaves.

Average dose.—1 fluidrachm (4 mils).

INFUSUM SENNÆ COMPOSITUM. U. S. Compound Infusion of Senna

[Inf. Senn. Co.]

	Metric	Old form
*Senna	60 Gm.	2 oz. av.
Manna	120 Gm.	4 oz. av.
Magnesium Sulphate	120 Gm.	4 oz. av.
Fennel, bruised	20 Gm.	292 gr.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Pour 800 mils [old form 25 fl. oz. 288 minims] of boiling water upon the senna, manna, and fennel contained in a suitable vessel, and allow the mixture to macerate for half an hour. Then strain, express and dissolve the magnesium sulphate in the Infusion, and again strain. Lastly, add enough water through the strainer to make the Infusion measure 1000 mils [old form 2 pints].

This preparation must not be dispensed unless it has been recently prepared.

Average dose.—4 fluidounces (120 mils).

INFUSUM BRAYERÆ. N. F. Infusion of Brayera

[Inf. Brayer.]

	Metric	Old form
Brayera, in No. 20 powder	60 Gm.	2 oz. av.
Boiling Water	1000 mils	2 pints

Pour the boiling water upon the brayera, and allow it to macerate in a covered vessel until cool.

Dispense this Infusion without straining, and only when recently prepared.

Average dose.—8 fluidounces (250 mils).

INFUSUM CINCHONÆ. N. F. Infusion of Cinchona

[Inf. Cinchon.]

	Metric	Old form
Cinchona, in No. 40 powder	60 Gm.	2 oz. av.
Aromatic Sulphuric Acid	10 mils	2½ fl. dr.
Water, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the acid with 500 mils [old form 1 pint] of water, and moisten the powder with 30 mils [old form 461 minims] of the mixture; pack it firmly in a conical glass percolator, and gradually pour upon it, first the remainder of the mixture, and afterwards water, until the infusion measures 1000 mils [old form 2 pints].

The acid in this infusion renders the alkaloids more soluble and thus assists in their extraction.

Average dose.—12 fluidrachms (50 mils).

INFUSUM GENTIANÆ COMPOSITUM. N. F. **Compound Infusion of Gentian**

[Inf. Gent. Co.]

	Metric	Old form
Gentian, in No. 40 powder	**30 Gm.**	1 oz. av.
Coriander, in No. 40 powder	**8 Gm.**	117 gr.
Bitter Orange Peel, in No. 40 powder	**8 Gm.**	117 gr.
Diluted Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the powdered drugs with diluted alcohol, pack in a percolator, and percolate with diluted alcohol until the product measures 250 mils [old form 8 fl. oz.]. To this add sufficient water to make the product measure 1000 mils [old form 2 pints].

Average dose.—4 fluidrachms (15 mils).

INFUSUM PRUNI VIRGINIANÆ. N. F. **Infusion of Wild Cherry**

(U. S. P. VIII)

[Inf. Prun. Virg.]

	Metric	Old form
Wild Cherry, in No. 20 powder	**40 Gm.**	1 oz. av. 147 gr.
Glycerin	**50 mils**	1 fl. oz. 288 min.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Macerate the wild cherry in 900 mils [old form 28 fl. oz. 384 minims] of cold water in a cylindrical percolator during three hours and then draw off and collect the percolate in a receiving bottle containing the glycerin. When the liquid has passed below the surface of the drug, press it down firmly and pour on sufficient water to make the infusion measure 1000 mils [old form 2 pints] and mix well.

This Infusion should not be dispensed unless it has been recently prepared. The preliminary maceration permits the development of hydrocyanic acid in the wild cherry and the process of cold percolation has been adopted to avoid the subsequent loss of this important constituent which the usual hot water method would have volatilized.

Average dose.—2 fluidounces (60 mils).

INFUSUM ROSÆ COMPOSITUM. N. F. **Compound Infusion of Rose**

[Inf. Ros. Co.]

	Metric	Old form
Red Rose	**13 Gm.**	190 gr.
Diluted Sulphuric Acid	**9 mils**	138 min.
Sugar	**40 Gm.**	1 oz. av. 147 gr.
Boiling Water	**1000 mils**	2 pints

Pour the boiling water upon the red rose in a glass or porcelain vessel, add the acid, cover the vessel, and digest the drug during one hour. Then dissolve the sugar in the liquid and strain the infusion.

Average dose.—3 fluidounces (100 mils).

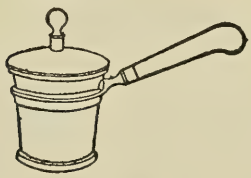
Unofficial Infusions

Title	Ingredients	Method of Preparation
Infusum Alstoniæ. Br.	50 Gm. Alstonia, bruised; boiling Distilled Water, 1000 mils	Infuse in a covered vessel for 30 minutes; strain
Aurantii. Br.	50 Gm. Dried Bitter Orange Peel; 1000 mils boiling Distilled Water	Infuse in a covered vessel for 15 minutes; strain
Aurantii Compositum. Br.	25 Gm. Dried Bitter Orange Peel; 10 Gm. Lemon Peel; 5 Gm. Cloves, bruised; 1000 mils boiling Distilled Water	Infuse in a covered vessel for 15 minutes; strain
Buchu. Br.	50 Gm. Buchu Leaves; 1000 mils boiling Distilled Water	Infuse in a covered vessel for 15 minutes; strain
Calumbæ. Br.	50 Gm. Calumba Root; 1000 mils boiling Distilled Water	Infuse for 30 minutes; strain
Caryophylli. Br.	25 Gm. Cloves, bruised; 1000 mils boiling Distilled Water	Infuse in a covered vessel for 15 minutes; strain
Cascarillæ. Br.	50 Gm. Cascarilla; 1000 mils boiling Distilled Water	Infuse in a covered vessel for 15 minutes; strain
Chiratæ. Br.	50 Gm. Chiretta; 1000 mils boiling Distilled Water	Infuse in a covered vessel for 15 minutes; strain
Ergotæ. Br.	50 Gm. Ergot, freshly crushed; 1000 mils boiling Distilled Water	Infuse in a covered vessel for 15 minutes; strain
Krameriæ. Br.	50 Gm. Krameria Root, bruised; 1000 mils boiling Distilled Water	Infuse in a covered vessel for 15 minutes; strain
Quassiæ. Br.	10 Gm. Quassia Wood, rasped; 1000 mils boiling Distilled Water	Infuse in a covered vessel for 15 minutes; strain
Rhei. Br.	50 Gm. Rhubarb Root, sliced; 1000 mils boiling Distilled Water	Infuse in a covered vessel for 15 minutes; strain
Salviæ	16 Gm. Sage; 500 mils Boiling Water	Infuse in a covered vessel for 30 minutes; strain
Scoparii. Br.	100 Gm. Broom Tops, bruised; 1000 mils boiling Distilled Water	Infuse in a covered vessel for 15 minutes; strain
Senegæ. Br.	50 Gm. Senega Root, No. 10 powder; 1000 mils boiling Distilled Water	Infuse in a covered vessel for 30 minutes; strain
Sennæ. Br.	100 Gm. Senna; 5 Gm. Ginger, sliced; 1000 mils boiling Distilled Water	Infuse in a covered vessel for 15 minutes; strain
Uvæ Ursi. Br.	50 Gm. Bearberry Leaves, bruised; 1000 mils boiling Distilled Water	Infuse in a covered vessel for 15 minutes; strain

Decocta *Decoctions*

Decoctions are liquid preparations made by *boiling* vegetable substances with water. The object sought in preparing decoctions is to secure, in aqueous solution, the soluble active principles of drugs which are not injured by heat. It is obvious that very few drugs are suited

FIG. 435



Block tin decoction vessel

FIG. 436

Brass water bath

to this form of administration; and decoctions are rapidly declining in favor. Hot infusion will generally afford a means of obtaining all the benefits that are derived from boiling the drug with water, while the

prolonged action of boiling water generally exercises a dissociating effect upon the active principles. The disadvantages of hot infusions are possessed in a more marked degree by decoctions (see page 449). In compound decoctions the ingredients are preferably added at different periods of the operation, the hard, ligneous drugs being added first, and the aromatics, or those containing volatile oils, at the close of the process, so that loss of activity of the latter may not ensue.

The earthen-ware or porcelain vessels used in preparing infusions are preferred for decoctions (see page 450), as they will bear the heat of boiling water, if heated gradually. Fig. 435 shows a block-tin vessel employed for preparing decoctions, used largely in Germany, and to some extent here. It is preferably used in connection with the brass water bath, R (see Fig. 436). The rim, F, is somewhat flexible, while a small aperture permits the escape of steam. The empyreumatic odor which many decoctions possess when made over a naked fire, and caused by particles adhering to the bottom of the vessel and becoming charred, is avoided by the use of the water bath.

Iron vessels are not used advantageously, because of the discoloration which is caused by the tannin of astringent drugs reacting with the iron.

A general formula for decoctions will be found in the U. S. P. IX and *one* formula in the N. F. IV.

DECOCTA. U. S. Decoctions

General Official Formula.—Decoctions must be *freshly made from the drugs*, and, when the strength of decoctions is not otherwise directed, they are to be prepared by the following general formula:

	Metric	Old form
***The Drug,** coarsely comminuted	**50 Gm.**	365 gr.
Water, a sufficient quantity,		
To make	**1000 mils**	1 pint

Introduce the drug into a suitable vessel provided with a cover, pour upon it 1000 mils [old form 1 pint] of cold water, cover it well, and boil for fifteen minutes. Then allow it to cool to about 40° C. (104° F.), express, strain the expressed liquid, and pass enough cold water through the strainer to make the product measure 1000 mils [old form 1 pint].

Caution.—The strength of decoctions of energetic or powerful substances should be specially directed by the physician.

DECOCTUM SARSAPARILLÆ COMPOSITUM. N. F. Compound Decoction of Sarsaparilla

[Decoc. Sarsap. Co.]

	Metric	Old form
Sarsaparilla, cut and bruised	**100 Gm.**	1 oz. av. 293 gr.
Sassafras, in No. 20 powder	**20 Gm.**	146 gr.
Guaiac Wood, rasped	**20 Gm.**	146 gr.
Glycyrrhiza, cut and bruised	**20 Gm.**	146 gr.
Mezereum, cut and bruised	**10 Gm.**	73 gr.
Water, a sufficient quantity,		
To make	**1000 mils**	1 pint

Add the sarsaparilla and guaiac wood to 1000 mils [old form 1 pint] of water in a suitable vessel and boil the mixture for thirty minutes, replacing the water lost by evaporation. Then add the sassafras, glycyrrhiza and mezereum, cover the vessel, and macerate the mixture for two hours. Finally strain, and add enough cold water, through the strainer, to make the product measure 1000 mils [old form 1 pint].

Average dose.—4 fluidounces (120 mils).

Unofficial Decoctions

Title	Ingredients	Method of Preparation
Decoctum Acaciæ Corticis. Br.	60 Gm. bruised Acacia Bark; Distilled Water, enough to make 1000 mils	Boil the drug with 1200 mils of Distilled Water for 10 minutes, strain and add enough Distilled Water to make 1000 mils
Agropyri. Br.	50 Gm. cut Couch Grass; Distilled Water, enough to make 1000 mils	Prepare as directed for Decoctum Acaciæ Corticis
Aloes Compositum. Br.	10 Gm. Extract of Aloes; 5 Gm. each of Myrrh and Potassium Carbonate; 40 Gm. Extract of Liquorice; 300 mils Compound Tincture of Cardamoms; Distilled Water, enough to make 1000 mils	Coarsely powder the Extract of Aloes and Myrrh and boil them with the Potassium Carbonate and Extract of Liquorice, in 400 mils of Water, for 5 minutes, then when cold add the Compound Tincture of Cardamoms, set aside for two hours, strain, and add enough Distilled Water to make 1000 mils
Cetrariæ. U. S. P. 1890	50 Gm. Cetraria; Water, enough to make 1000 mils	Infuse the Cetraria, during 30 minutes, with 400 mils of Cold Water, express, and throw the liquid away. Boil the residue with 1000 mils of Water for 30 minutes, strain, and add Water to make 1000 mils
Gossypii Radicis Corticis. Br.	200 Gm. bruised Cotton Root Bark; Distilled Water, enough to make 1000 mils	Boil the drug with 2000 mils of Distilled Water until reduced to about 1000 mils, strain, and add enough Water to make exactly 1000 mils
Hæmatoxyli. Br.	50 Gm. Logwood, in chips; 10 Gm. Cinnamon Bark, bruised; Distilled Water to make 1000 mils	Boil the Logwood with 1200 mils of Water for 10 minutes, adding the Cinnamon Bark toward the end of the time, strain, and add Water to make 1000 mils
Ispaghulæ. Br.	15 Gm. bruised Ispaghula; Distilled Water, enough to make 1000 mils	Prepare as directed for Decoctum Acaciæ Corticis
Sappan. Br.	50 Gm. Sappan, in chips; 10 Gm. bruised Cinnamon Bark; Distilled Water, enough to make 1000 mils	Prepare as directed for Decoctum Hæmatoxyli
Sarsaparillæ Compositum Fortius (Zittmann's Decoction, Stronger)	20 Gm. cut Sarsaparilla; 1 Gm. Sugar; 1 Gm. Alum; 1 Gm. bruised Anise; 1 Gm. Bruised Fennel; 5 Gm. cut Senna; 2 Gm. cut Liquorice Root; Water, enough to make 500 mils	Macerate the Sarsaparilla in 520 mils of Water for 24 hours, add the Sugar and Alum and digest on a water bath for 3 hours, then add the Anise, Fennel, Senna and Liquorice Root and digest for 15 minutes; strain and add enough Water to make 500 mils
Sarsaparillæ Compositum Mitius (Zittmann's Decoction, Milder)	10 Gm. cut Sarsaparilla; 1 Gm. cut Lemon Peel; 1 Gm. bruised Cinnamon; 1 Gm. bruised Cardamom; 1 Gm. cut Liquorice Root; Water, enough to make 500 mils	Macerate the Sarsaparilla in 480 mils of Water, for 24 hours, then digest on a water bath for 3 hours and afterwards add the Lemon Peel, Cinnamon, Cardamom and Liquorice Root, digest for 15 minutes, strain and add enough Water to make 500 mils

Species

This is a class of preparations, usually consisting of dried herbs, usually intended for the making of medicinal teas. *Three* species are recognized in the National Formulary, as follows:

SPECIES EMOLLIENTES. N. F. Emollient Species

[Spec. Emoll. Emollient Cataplasm]

	Metric	Old form
Althæa Leaves	20 Gm.	350 gr.
Mallow Leaves	20 Gm.	350 gr.
Melilot	20 Gm.	350 gr.
Matricaria	20 Gm.	350 gr.
Linseed	20 Gm.	350 gr.
To make	100 Gm.	4 oz. av.

Reduce the drugs to a coarse powder, and mix them uniformly.

Note.—To prepare an *Emollient Poultice*, add a suitable quantity of hot water to this powder.

SPECIES LAXATIVÆ. N. F. Laxative Species

[Spec. Lax. Species Laxantes, N. F. III St. Germain Tea]

	Metric	Old form
Senna, cut	40.0 Gm.	1 oz. av. 262 gr.
Sambucus	25.0 Gm.	1 oz. av.
Fennel, bruised	12.5 Gm.	219 gr.
Anise, bruised	12.5 Gm.	219 gr.
Potassium Bitartrate, in fine powder	10.0 Gm.	175 gr.
To make	100 Gm.	4 oz. av.

Moisten the senna with a small quantity of water; then sprinkle the potassium bitartrate over it as uniformly as possible. When the senna so treated has become dry, mix it lightly and uniformly with the other ingredients.

Average dose.—20 grains (1.3 Gm.).

SPECIES PECTORALES. N. F. Pectoral Species

[Spec. Pect. Species ad Infusum Pectorale Breast Tea]

	Metric	Old form
Althæa	40 Gm.	1 oz. 262 gr.
Coltsfoot	20 Gm.	350 gr.
Glycyrrhiza, Russian	15 Gm.	262 gr.
Anise	10 Gm.	175 gr.
Mullein Flowers	10 Gm.	175 gr.
Orris	5 Gm.	87 gr.
To make	100 Gm.	4 oz. av.

Cut, bruise, and intimately mix the ingredients.

Average dose.—1 drachm (4 Gm.).

QUESTIONS ON AQUEOUS LIQUIDS MADE BY PERCOLATION OR MACERATION AND ON SPECIES

What are infusions? (See page 449.)
In making infusions, should the substances be boiled?
In what cases is hot water preferable? Cold water?
What inert principles found in drugs are extracted by hot water, and what by cold water?
What is the objection to using fine powders in making infusions?
Name the infusions official in the U. S. P. Those in the N. F.
By what four methods are infusions usually made?
Describe the general process of the U. S. P.
Describe Alsop's infusion jar. Squire's infusion mug.
What special advantage has this mug?
How may a cheap and convenient apparatus be made?

What official infusions are made by maceration?
How is the process of digestion used in making infusions?
Is percolation a good process for making infusions?
What are its advantages?
What is its chief disadvantage?
What official infusions are made by percolation?
How may infusions be preserved?
What is the objection to the use of antiseptics?
Describe a method of preserving infusions which is dependent upon sterilization.
Is the method of making infusions from fluidextracts a desirable one?
What are the objections to it?
Give the formula and details for making infusion of digitalis. Compound infusion of senna.
How is infusion of brayera made? Why is it not strained? Why is acid used in infusion of cinchona?
Name the ingredients in compound infusion of gentian.
Why is infusion of wild cherry macerated before percolation and then made without heat?
What is the formula for making compound infusion of rose?
What are decoctions?
What is the object sought in preparing decoctions?
What are the disadvantages attending decoctions?
In making decoctions, should all the ingredients be put in together? Why?
How may the empyreumatic odor which sometimes occurs in decoctions be avoided?
Are iron vessels used advantageously in making decoctions? Why?
Are there any decoctions now official?
Give the general official formula for making a decoction, where the strength has not been directed or specified.
Name the ingredients in compound decoction of sarsaparilla.
Give the Latin name, formula, and mode of making Zittmann's stronger decoction. Zittmann's milder decoction.
What are species? How many are official in the N. F.?
Give the Latin and English titles and the synonyms for each.

CHAPTER XXVII

ALCOHOLIC LIQUIDS MADE BY PERCOLATION OR MACERATION

Tincturæ *Tinctures*

TINCTURES are alcoholic preparations made by extracting the valuable principles from drugs by the use of appropriate menstrua or solvents. There are, however, several exceptions, in which chemical substances are dissolved in alcoholic liquids. They differ from spirits in being made from *non-volatile* bodies, the tinctures containing iodine being the only exception to this rule. They are made by percolation, maceration, solution, or dilution, and the menstrua employed in the official tinctures are alcohol, dilute alcohol of various strengths, aromatic spirit of ammonia, ether, ammonia water, or mixtures of alcohol, water, and glycerin. There are *fifty-four* tinctures official in the U. S. P. IX and *forty-eight* in the N. F. IV. In some unofficial tinctures, spirit of ether, ammoniated alcohol, and spirit of nitrous ether are used. The use of alcohol as a solvent for the active or useful principles in drugs has been practiced for many years, but it has required a long time and much experience to determine the proper proportion of water to add to the alcohol so that the menstrua should thoroughly exhaust the drugs without extracting the inert principles, and yet contain sufficient alcohol to secure permanent preparations that will not in time deposit a portion of their active constituents. The advantages of alcohol as a menstruum have been proved so thoroughly, that the use of aqueous preparations has greatly declined in this country; and yet there are some instances, particularly in the case of the weak tinctures and those requiring a large dose, in which the therapeutic action of the menstruum almost equals that of the drug. In these cases, however, the physician may prefer the fluidextract when he does not desire the stimulating action of the alcohol in the tincture.

In selecting the menstrua the proportion of water in each case is made as great as possible without endangering the permanency of the preparation, one especial advantage being that such tinctures may be added in small proportions to aqueous preparations without serious precipitation. In this respect tinctures have usually a great advantage over fluidextracts, and weaker alcoholic menstrua are often used successfully for tinctures when such would be entirely unsuitable for fluidextracts. This may be explained by the fact that tinctures, on account of their comparative weakness, have a much larger proportion of menstruum than fluidextracts with which to exhaust the drug, and may therefore have the excess over the proportion of alcohol used in the fluidextract made up with water. It has been proved that a pint of diluted alcohol will extract by percolation a larger proportion of the soluble principles of a drug than half a pint of alcohol and half a pint of water percolated separately through the drug. The properties of *alcohol* are considered under another head (Part IV), yet it seems desirable to notice here the solvent properties of this valuable preservative. It mixes freely with water, ether, acetic acid, a number of volatile oils, and castor oil; it dissolves resins, camphor, tannin, benzoic acid, chlorophyl, the alkaloids, balsams, iodine, ferric chloride, ammonium carbonate, etc. *Diluted alcohol* extracts from drugs, gum, extractive, chlorophyl, albu-

men, coloring matter, resins, volatile oils, alkaloids, sugar, tannin, etc. *Glycerin* is used in tinctures to prevent precipitation by retaining in solution principles which would otherwise in time be deposited.

Preparation.—Tinctures are officially made in three ways: 1. By percolation. 2. By maceration. 3. By solution or dilution.

1. **By Percolation.**—This is the best method for making tinctures, when the drugs are capable of being readily comminuted and displaced, and it is always directed by the Pharmacopœia when practicable. The special advantages of percolation over maceration and expression are seen in the saving of time and labor, and in the greater efficiency of the product if the process has been carefully and skilfully performed. The introduction of metric measures into the U. S. Pharmacopœia of 1890 has greatly simplified the working formulas, there being now no calculations necessary to determine the end product; the employment of metric receiving bottles in percolating operations secures accuracy within reasonable limits, and their convenience will always be a recommendation. The use of parts by weight for tinctures proved unsatisfactory. If the drugs from which the tinctures are directed to be made could be standardized so that they would always contain a definite and uniform weight of the active principles, there might be an advantage in bringing the end product to a weight which would bear a simple relation to the proportion of active principles selected as a standard; but the Pharmacopœia, for obvious reasons, has not fixed a limit for even the amount of moisture in the air-dried drugs, and to assay all of them and to fix a maximum and minimum limit of each active principle present in each drug would be impracticable, and in most cases impossible. Now, the variation in the amount of moisture and in the proportion of active principles in commercial drugs is far greater than is generally supposed; and so long as this ever-present bar to uniformity is not overcome, it is useless to regard the trifling advantage supposed to exist in favor of accuracy and convenience in weighing liquids; practically, the question of accuracy resolves itself into one of personal error, for a careful operator will make more accurate tinctures by using measures than a careless one will by using weights, and *vice versa*. The U. S. P. IX has provided a Type Process for tinctures which are to be made by *Percolation*. In the text, under the title, only the drug, the size of the powder, and the menstruum are given and reference is then made to the Type Process. In this book complete formulas will be found under each title. The U. S. P. "Type Process P" for percolation will be found on page 463.

2. **By Maceration.**—This method of making tinctures is officially used in the case of resins, balsams, gums, soap, etc., where the practical difficulties likely to be encountered in percolation would offset any advantages that the latter process might possess (see page 269). The U. S. P. IX also provides a Type Process for tinctures to be made by *Maceration*, only giving the title, drug, size of powder, and the menstruum, with reference to the Type Process. This plan has not been followed in this book; each formula is complete. The U. S. P. "Type Process M" for maceration will be found on page 463.

3. **By Solution or Dilution.**—A few tinctures are made in this way, such as tincture of iodine, by dissolving iodine in a solution of potassium iodide and adding alcohol; tincture of ferric chloride by diluting the solution of ferric chloride with alcohol, etc.

The proportion of the drug to the finished product varies in the class

of tinctures, but at the eighth revision of the U. S. Pharmacopœia an attempt was made to bring about some degree of uniformity by making the majority of them of two strengths—10 per cent. if made from potent drugs, 20 per cent. if made from drugs which are not classed as powerful in their action. The selection of 10 per cent. as the strength for potent tinctures was made by the International Conference held at Brussels in 1902, and as it is most desirable to promote uniformity in the strength of potent remedies throughout the world, the U. S. Pharmacopœia adopted the proposition, but, instead of weighing the finished product so as to prepare preparations of definite percentage strength, the American custom of measuring the finished product was adopted and the strength of tinctures is properly expressed as "10 Gm. of drug in 100 mils" or "20 Gm. of drug in 100 mils." For all practical purposes the U. S. P. tinctures conform to the International standard, as the difference in strength caused by this change is negligible, and in consequence in 1905 there was a reduction of strength of many of the strong tinctures, the most important changes being that of tincture of aconite from 35 per cent. to 10 per cent. and of tincture of veratrum viride from 40 per cent. to 10 per cent. A number of assay processes for tinctures containing alkaloids have been introduced in the U. S. P. and N. F. and these will serve to bring about reliability and uniformity in strength.

Tincturæ *Tinctures*

The U. S. P. IX has adopted *General Formulas* for a number of tinctures, as given below, but in this book each tincture will be found to be complete in its detail without the inconvenience and uncertainty of reference to a General Formula.

Type Process P—Percolation.—Moisten the powdered drug or mixed drugs designated in the formula with a sufficient quantity of the prescribed menstruum to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, unless otherwise directed, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the menstruum to make 1000 mils of finished tincture.

Modification for Assayed Tinctures.—In tinctures that are directed to be assayed, allow the percolation to proceed until the percolate measures 950 mils. Assay a sample of this percolate as directed and from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloids in the remainder of the liquid and add to this enough of the menstruum to make the finished tincture conform to the required alkaloidal standard.

Type Process M—Maceration.—Macerate the drug or mixed drugs designated in the formula in a stoppered container, in a moderately warm place, with 750 mils of the prescribed solvent (unless a different amount is specified in the formula). Continue the maceration with frequent agitation during three days or until the drug is practically extracted, transfer the mixture to a filter and, when the liquid has drained off completely, gradually wash the residue on the filter with enough of the solvent to make 1000 mils of finished tincture.

The following tables exhibit the U. S. P. IX tinctures, classified so as to show their relative strength both as to weight and volume, the variations in menstrua, and other useful data:

U. S. P. IX Tinctures arranged in the Order of their Relative Strength and other Data

Number of Grammes of most Active Ingredients represented by 100 mils	Number of Grains of most Active Ingredients represented by a Fluidrachm	Official Title	Fineness of Powder	Menstruum	Ingredients in 1000 mils
0.4	0.23	Tinctura Opii Camphorata	....	Dil. Alcohol, 96; Glycerin, 4	4 Gm. Powdered Opium; 4 Gm. Benzoic Acid; 4 Gm. Camphor; 4 mils Oil of Anise
5	2.85	Gambir Composita	50	Dil. Alcohol	50 Gm. Gambir; 25 Gm. Saigon Cinnamon
5	2.85	Moschi	....	Alc. 50; Wat. 50	50 Gm. Musk
5.5	3.14	Lavandulæ Composita	50	Alc. 75; Wat. 25	8 mils Oil of Lavender; 2 mils Oil of Rosemary; 20 Gm. Saigon Cinnamon; 5 Gm. Clove; 10 Gm. Myristica; 10 Gm. Red Saunders
6.2	3.53	Cardamomi Compositа	....	Dil. Alcohol, 95; Glycerin, 5	20 Gm. Cardamom Seed; 25 Gm. Saigon Cinnamon; 12 Gm. Caraway; 5 Gm. Cochineal
6.5 to 7.5	3.70 to 4.27	Iodi	....	Alc. 95; Wat. 5	70 Gm. Iodine; 50 Gm. Potassium Iodide
10	5.70	Aconiti	60	Alc. 70; Wat. 30	100 Gm. Aconite. Assayed chemically and biologically
10	5.70	Aloes	40	Dil. Alcohol	100 Gm. Aloes; 200 Gm. Glycyrrhiza
10	5.70	Belladonnæ Foliorum	60	Dil. Alcohol	100 Gm. Belladonna Leaves. Assayed
10	5.70	Cannabis	40	Alcohol	100 Gm. Cannabis. Assayed biologically
10	5.70	Cantharidis	60	Alcohol	100 Gm. Cantharides
10	5.70	Capsici	50	Alc. 95; Wat. 5	100 Gm. Capsicum
10	5.70	Colchici Seminis	50	Alc. 60; Wat. 40	100 Gm. Colchicum Seed. Assayed
10	5.70	Digitalis	60	Alc. 75; Wat. 25	100 Gm. Digitalis. Assayed biologically
10	5.70	Gelsemii	60	Alc. 65; Wat. 35	100 Gm. Gelsemium
10	5.70	Gentianæ Compositа	40	Alc. 50; Wat. 40; Glycerin, 10	100 Gm. Gentian; 40 Gm. Bitter Orange Peel; 10 Gm Cardamom Seed
10	5.70	Hyoscyami	60	Dil. Alcohol	100 Gm. Hyoscyamus. Assayed
10	5.70	Kino	....	Alc. 50; Wat. 50	100 Gm. Kino
10	5.70	Lobeliæ	50	Dil. Alcohol	100 Gm. Lobelia
10	5.70	Nucis Vomicæ	40	Alc. 75; Wat. 25	100 Gm. Nux Vomica. Assayed
10	5.70	Opii	....	Alc. 50; Wat. 50	100 Gm. Granulated Opium. Assayed
10	5.70	Opii Deodorati	....	Alc. 20; Wat. 80	100 Gm. Granulated Opium. Assayed
10	5.70	Physostigmatis	50	Alcohol	100 Gm. Physostigma. Assayed
10	5.70	Sanguinariæ	60	Hydrochloric Acid 1; alc. 60; wat. 40	100 Gm. Sanguinaria
10	5.70	Scillæ	20	Alc. 75; Wat. 25	100 Gm. Squill. Assayed biologically
10	5.70	Stramonii	60	Dil. Alcohol	100 Gm. Stramonium Assayed
10	5.70	Strophanthi	40	Benzin exhaustion, then Alcohol	100 Gm. Strophanthus. Assayed biologically
10	5.70	Veratri Viridis	60	Alcohol	100 Gm. Veratrum
13	7.41	Ferri Chloridi	....	Alc. 65; Solution 35	350 mils Solution of Ferric Chloride
15	8.55	Cardamomi	40	Dil. Alcohol	150 Gm. Cardamom Seed
20	11.40	Arnicæ	20	Dil. Alcohol	200 Gm. Arnica
20	11.40	Asafœtidæ	Bruised	Alcohol	200 Gm. Asafetida
20	11.40	Aurantii Amari	40	Alc. 60; Wat. 40	200 Gm. Bitter Orange Peel
20	11.40	Benzoini	40	Alcohol	200 Gm. Benzoin
20	11.40	Calumbæ	20	Alc. 60; Wat. 40	200 Gm. Calumba
20	11.40	Cinchonæ	40	Alc. 67.5; Wat. 25; Glycerin, 7.5	200 Gm. Cinchona. Assayed

Tinctures, U. S. P.—*Continued*

Number of Grammes of most Active Ingredients represented by 100 mils	Number of Grains of most Active Ingredients represented by a Fluidrachm	Official Title	Fineness of Powder	Menstruum	Ingredients in 1000 mils
20	11.40	Tinctura Cinchonæ Composita	....	Alc. 67.5; Wat. 25; Glycerin, 7.5	100 Gm. Red Cinchona; 80 Gm. Bitter Orange Peel, 20 Gm. Serpentaria
20	11.40	Cinnamomi	50	Alc. 67.5; Wat. 25; Glycerin, 7.5	200 Gm. Saigon Cinnamon
20	11.40	Guaiaci	40	Alcohol	200 Gm. Guaiac
20	11.40	Guaiaci Ammoniata	40	Aromatic Spirit of Ammonia	200 Gm. Guaiac
20	11.40	Hydrastis	60	Alc. 60; Wat. 30	200 Gm. Hydrastis. Assayed
20	11.40	Myrrhæ	Coarse powder	Alcohol	200 Gm. Myrrh
20	11.40	Pyrethri	50	Alcohol	200 Gm. Pyrethrum
20	11.40	Quassiæ	50	Alc. 30; Wat. 60	200 Gm. Quassia
20	11.40	Rhei	40	Alc. 50; Wat. 40; Glycerin, 10	200 Gm. Rhubarb; 30 Gm. Cardamom Seed
20	11.40	Rhei Aromatica	40	Alc. 50; Wat. 40; Glycerin, 10	200 Gm. Rhubarb; 40 Gm. Saigon Cinnamon; 40 Gm. Clove; 20 Gm. Myristica
20	11.40	Tolutana	....	Alcohol	200 Gm. Balsam of Tolu
20	11.40	Valerianæ	40	Alc. 75; Wat. 25	200 Gm. Valerian
20	11.40	Valerianæ Ammoniata	40	Aromatic Spirit of Ammonia	200 Gm. Valerian
20	11.40	Zingiberis	30	Alcohol	200 Gm. Jamaica Ginger
24	13.68	Benzoini Compositа	....	Alcohol	100 Gm. Benzoin; 20 Gm. Aloes; 80 Gm. Storax; 40 Gm. Balsam of Tolu
50	28.50	Aurantii Dulcis	....	Alcohol	500 Gm. Sweet Orange Peel (fresh)
50	28.50	Lactucarii	....	Benzin exhaustion, then Alc.50; Wat. 25; Glycerin, 25	500 Gm. Lactucarium
50	28.50	Limonis Corticis	....	Alcohol	500 Gm. Lemon Peel (fresh)

Table of the U.S.P. Compound Tinctures (arranged Alphabetically) with Data showing Total Amount of Ingredients represented by the Tincture

Total number of Grammes of Ingredients represented by 100 mils	Total number of Grains of Ingredients represented by one fluidrachm	Official Title	Ingredients in 1000 mils
30	17.10	Aloes	100 Gm. Aloes; 200 Gm. Glycyrrhiza
24	13.68	Benzoini Compositа	100 Gm. Benzoin; 20 Gm. Aloes; 80 Gm. Storax; 40 Gm. Balsam of Tolu
6.2	3.53	Cardamomi Compositа	20 Gm. Cardamom Seed; 25 Gm. Saigon Cinnamon; 12 Gm. Caraway; 5 Gm. Cochineal
20	11.40	Cinchonæ Compositа	100 Gm. Red Cinchona; 80 Gm. Bitter Orange Peel; 20 Gm. Serpentaria
7.5	4.27	Gambir Composita	50 Gm. Gambir; 25 Gm. Saigon Cinnamon
15	8.55	Gentianæ Compositа	100 Gm. Gentian; 40 Gm. Bitter Orange Peel; 10 Gm. Cardamom Seed
5.5	3.13	Lavandulæ Compositа	8 mils Oil of Lavender; 2 mils Oil of Rosemary; 20 Gm. Saigon Cinnamon; 5 Gm. Clove; 10 Gm. Myristica; 10 Gm. Red Saunders
1.6	0.91	Opii Camphorata	4 Gm. Powdered Opium; 4 Gm. Benzoic Acid; 4 Gm. Camphor; 4 mils Oil of Anise
23	13.11	Rhei	200 Gm. Rhubarb; 30 Gm. Cardamom Seed
30	17.10	Rhei Aromatica	200 Gm. Rhubarb; 40 Gm. Saigon Cinnamon; 40 Gm. Clove; 20 Gm. Myristica

N. F. IV Tinctures arranged in the Order of their Relative Strength, and other Data

Number of Grammes of most Active Ingredients represented by 100 mils	Number of Grains of most Active Ingredients represented by a Fluidrachm	Official Title	Fineness of Powder	Menstruum	Ingredients in 1000 mils
1.4	0.80	Tinctura Pectoralis	....	Dil. Alcohol	42 mils Tincture of Opium; 64 mils Compound Tincture of Gambir; 40 mils Spirit of Camphor; 1 mil Oil of Anise; 16 Gm. Caramel
2.2 $FeCl_3$	0.68	Ferri Chloridi Ætherea	....	Alc. 69; Ether, 25; Solution $FeCl_3$, 6	60 mils Solution of Ferric Chloride; 250 mils Ether; Alcohol, enough to make 1000 mils
about 4	about 2.28	Kino et Opii Composita	....	Dil. Alcohol	200 mils Tincture of Kino; 100 mils Tincture of Opium; 65 mils Spirit of Camphor; 1.5 mils Oil of Clove; 8.5 Gm. Cochineal; 8 mils Aromatic Spirit of Ammonia
6.185	3.52	Antiperiodica sine Aloe	30	Alc. 60; Wat. 40	The same as Antiperiodic Tincture except for the omission of the Extract of Aloes
7.935	4.52	Antiperiodica	30	Alc. 60; Wat. 40	8 Gm. Rhubarb; 8 Gm. Angelica Fruit; 4 Gm. Inula; 4 Gm. Saffron; 4 Gm. Fennel; 2 Gm. Gentian; 2 Gm. Zedoary; 2 Gm. Cubeb; 2 Gm. Myrrh; 2 Gm. Camphor; 2 Gm. Agaric; 0.35 Gm. Pepper; 0.75 Gm. Saigon Cinnamon; 0.75 Gm. Ginger; 20 Gm. Quinine Bisulphate; 17.5 Gm. Extract of Aloes
8.3	4.7	Iodi Decolorata	....	About 80 per cent. alcohol	83 Gm. Iodine; 83 Gm. Sodium Thiosulphate; 100 mils Water; 65 mils Stronger Ammonia Water; Alcohol, enough to make 1000 mils
8.75	5.0	Rhei et Gentianæ	40	Dil. Alcohol	70 Gm. Rhubarb; 17.5 Gm. Gentian
10	5.7	Bryoniæ	40	Alcohol	100 Gm. Bryonia
10	5.7	Caramellis	....	Alc. 25; Wat. 75	100 Gm. Caramel
10	5.7	Cocculi Indici	30	Dil. Alcohol	100 Gm. Cocculus Indicus
10	5.7	Croci	Entire	Dil. Alcohol	100 Gm. Saffron
10	5.7	Delphinii	30	Alcohol	100 Gm. Larkspur Seed
10	5.7	Ferri Pomata	....	Alc. 10; Wat. 90	100 Gm. Ferrated Extract of Apples; Alcohol 100 mils; Cinnamon Water, enough to make 1000 mils
10	5.7	Ignatiæ	60	Alc. 80; Wat. 10	100 Gm. Ignatia. 100 mils of Tincture contains from 0.18 to 0.22 Gm. of Ignatia Alkaloids
10	5.7	Opii Crocata	....	Dil. Alcohol	100 Gm. Granulated Opium; 25 Gm. Saffron; 6 Gm. Saigon Cinnamon; 6 Gm. Clove. 100 mils of Tincture contains from 0.95 to 1.05 Gm. anhydrous morphine
10	5.7	Persionis	Fine	Alc. 75; Wat. 25	100 Gm. Cudbear
10	5.7	Pulsatillæ	30	Alc. 75; Wat. 25	100 Gm. Pulsatilla
10	5.7	Rhei Aquosa	....	Alc. 11; Wat. 89	100 Gm. Rhubarb; 10 Gm. Potassium Carbonate; 125 mils Cinnamon Water; 110 mils Alcohol; Water, enough to make 1000 mils

N. F. IV Tinctures—*(Continued)*

Number of Grammes of most Active Ingredients represented by 100 mils	Number of Grains of most Active Ingredients represented by a Fluidrachm	Official Title	Fineness of Powder	Menstruum	Ingredients in 1000 mils
10	5.7	Tinctura Rhei Dulcis	40	Glycerin, 10; Alc. 50; Wat. 40	100 Gm. Rhubarb; 40 Gm. Glycyrrhiza; 40 Gm. Anise; 10 Gm. Cardamom Seed
10	5.7	Sumbul	30	Alc. 60; Wat. 30	100 Gm. Sumbul
10	5.7	Vanillæ	Cut	Dil. Alcohol	100 Gm. Vanilla; 200 Gm. Sugar
11.5	6.5	Persionis Composita	Fine	Alc. 30; Wat. 60	15 Gm. Cudbear; 100 Gm. Caramel
12.5	7.1	Guaiaci Composita	....	Dil. Alcohol	125 Gm. Guaiac; 6 Gm. Potassium Carbonate; 32 Gm. Pimenta; 65 Gm. Pumice
12.5	7.1	Paracoto	40	Alcohol	125 Gm. Paracoto
13.2 $FeCl_3$	7.5	Ferri Citro-Chloridi	....	15 per cent. Alcohol	350 mils Solution of Ferric Chloride; 500 Gm. Sodium Citrate
15	8.5	Capsici et Myrrhæ	....	Alc. 90; Wat. 10	30 Gm. Capsicum; 120 Gm. Myrrh
15.5	8.8	Jalapæ Composita	60	Alc. 60; Wat. 30	125 Gm. Jalap; 30 Gm. Resin of Scammony
16.5	9.4	Iodi Fortior	....	Alc. 75; Wat. 25	165 Gm. Iodine; 33 Gm. Potassium Iodide
19.5	11.1	Viburni Opuli Composita	40	Glycerin, 7.5; Alc. 75; Wat. 17.5	35 Gm. Viburnum Opulus; 35 Gm. Dioscorea; 10 Gm. Scutellaria; 50 Gm. Clove; 65 Gm. Saigon Cinnamon
20	11.4	Aloes et Myrrhæ	40	Alc. 75; Wat. 25	100 Gm. Aloes; 100 Gm. Myrrh; 100 Gm. Glycyrrhiza
20	11.4	Amara	40	Alc. 60; Wat. 30	60 Gm. Gentian; 60 Gm. Centaury; 60 Gm. Bitter Orange Peel; 20 Gm. Zedoary
20	11.4	Aromatica	....	Alc. 60; Wat. 30	100 Gm. Saigon Cinnamon; 40 Gm. Jamaica Ginger; 20 Gm. Galangal; 20 Gm. Clove; 20 Gm. Cardamom Seed
20	11.4	Calendulæ	20	Alcohol	200 Gm. Calendula
20	11.4	Cimicifugæ	40	Alcohol	200 Gm. Cimicifuga
20	11.4	Cubebæ	30	Alcohol	200 Gm. Cubeb
20	11.4	Gallæ	60	Glycerin, 10; Alc. 90	200 Gm. Nutgall
20	11.4	Humuli	40	Dil. Alcohol	200 Gm. Hops
20	11.4	Ipecacuanhæ et Opii	....	Dil. Alcohol	1000 mils Tincture of Deodorized Opium (evaporated); 100 mils Fluidextract of Ipecac
20	11.4	Jalapæ	60	Alc. 60; Wat. 30	200 Gm. Jalap
20	11.4	Krameriæ	40	Dil. Alcohol	200 Gm. Krameria
20	11.4	Passifloræ	20	Dil. Alcohol	200 Gm. Passion Flower
20	11.4	Pimpinellæ	40	Alc. 60; Wat. 30	200 Gm. Pimpinella
20	11.4	Quillajæ	20	Alc. 35; Wat. 65	200 Gm. Quillaja
20	11.4	Serpentariæ	50	Alc. 60; Wat. 30	200 Gm. Serpentaria
25	14.2	Ergotæ Ammoniata	20	Ammonia Water, 10; Alc. 60; Wat. 20	250 Gm. Ergot
26.5	15.1	Sabal et Santali	....	Alc. 80; Wat. 20	200 Gm. Sabal, in No. 16 powder; 65 Gm. Sandalwood, in No. 60 powder
50	28.5	Cacti Grandiflori	Crushed	Alcohol	500 Gm. Cactus Grandiflorus

Unofficial Tinctures

Title	Ingredients	Method of Preparation
Tinctura Alstoniæ. Br.	125 Gm. Alstonia, No. 20 powder; Alcohol (60 per cent.) 1000 mils	Prepared by maceration
Arnicæ Radicis. U. S. P. 1890	100 Gm. Arnica Root, No. 40 powder; Alcohol (65 per cent.) to make 1000 mils	Percolate the drug with the menstruum to make 1000 mils
Berberidis. Br.	100 Gm. Berberis, No. 60 powder; Alcohol (60 per cent.), enough to make 1000 mils	Percolate the drug with the Alcohol, after 24 hours maceration, to make 1000 mils
Buchu. Br.	200 Gm. Buchu Leaves, No. 20 powder; Alcohol (60 per cent.) to make 1000 mils	Percolate the drug with the menstruum, after 24 hours maceration, to make 1000 mils
Cascarillæ. Br.	200 Gm. Cascarilla, No. 40 powder; Alcohol (70 per cent.) to make 1000 mils	Percolate the drug with the menstruum, after 24 hours maceration, to make 1000 mils
Chiratæ. Br. U. S. P. 1890	100 Gm. Chirata, No. 40 powder; Alcohol (about 60 per cent.) to make 1000 mils	Percolate the drug with the menstruum, after 24 hours maceration, to make 1000 mils
Chloroformi et Morphinæ Compositæ. Br.	75 mils Chloroform; 10 Gm. Morphine Hydrochloride; 50 mils Diluted Hydrocyanic Acid; 25 mils Tincture of Capsicum; 100 mils Tincture of Indian Hemp; 2 mils Oil of Peppermint; 250 mils Glycerin; Alcohol (90 per cent.) to make 1000 mils	Mix the Chloroform, Tinctures of Capsicum, and Indian Hemp, Oil of Peppermint, and Glycerin with 450 mils of Alcohol, dissolve the Morphine Hydrochloride in the mixture, add the Diluted Hydrocyanic Acid and then Alcohol, enough to make 1000 mils
Cocci. Br.	100 Gm. Cochineal, in powder; Alcohol (45 per cent.) enough to make 1000 mils	Macerate during seven days, frequently agitating, strain, express, and filter liquid if necessary
Daturæ Seminum. Br.	250 Gm. Datura Seeds, No. 20 powder; Alcohol (70 per cent.) enough to make 1000 mils	Percolate the drug with the Alcohol, after 24 hours maceration, to make 1000 mils
Hamamelidis. Br.	100 Gm. Hamamelis Bark, No. 20 powder; Alcohol (45 per cent.) to make 1000 mils	Percolate the drug with the menstruum, after 24 hours maceration, to make 1000 mils
Kaladanæ. Br.	200 Gm. Kaladana, No. 40 powder; Alcohol (70 per cent.), enough to make 1000 mils	Percolate the drug with the Alcohol, after 24 hours maceration, to make 1000 mils
Lobeliæ Ætherea. Br.	200 Gm. Lobelia, No. 40 powder; Spirit of Ether, enough to make 1000 mils	Percolate the drug with Spirit of Ether, after macerating for 24 hours, to make 1000 mils
Matico. U. S. P. 1890	100 Gm. Matico, No. 40 powder; Diluted Alcohol to make 1000 mils	Percolate the drug with Diluted Alcohol after maceration for 24 hours, to make 1000 mils
Oliveri Corticis. Br.	100 Gm. Oliver's Bark, No. 40 powder; Alcohol (60 per cent.), enough to make 1000 mils	Percolate the drug with the Alcohol after 24 hours maceration, to make 1000 mils
Opii Ammoniata. Br.	150 mils Tincture of Opium; 20 Gm. Benzoic Acid; 5 mils Oil of Anise; 200 mils Solution of Ammonia (10 per cent.); Alcohol (90 per cent.) to make 1000 mils	Dissolve the Oil of Anise and Benzoic Acid in 600 mils of Alcohol; add the Tincture of Opium and Solution of Ammonia, mix, filter, and add enough of the Alcohol to make 1000 mils
Picrorhizæ. Br.	250 Gm. Picrorhiza, cut and bruised; Alcohol (45 per cent.), enough to make 1000 mils	Prepare by maceration
Podophylli. Br.	36.5 Gm. Podophyllum Resin; Alcohol (90 per cent.) to make 1000 mils	Add the Resin to 900 mils of the Alcohol; set aside for 24 hours, occasionally agitating; filter, and add enough Alcohol to make 1000 mils
Podophylli Indici. Br.	36.5 Gm. Indian Podophyllum Resin; Alcohol (90 per cent.), enough to make 1000 mils	Prepare by maceration
Pruni Virginianæ. Br.	200 Gm. Wild Cherry Bark, No. 20 powder; 565 mils Alcohol; 365 mils Distilled Water; 100 mils Glycerin	Mix the drug with the Water; set aside for 24 hours, then add the Alcohol and macerate during seven days, frequently agitating; strain, express, and filter the liquid if necessary
Quininæ. Br.	20 Gm. Quinine Hydrochloride; 1000 mils Tincture of Orange	Dissolve the Quinine Hydrochloride in the Tincture of Orange
Quininæ Ammoniata. Br.	20 Gm. Quinine Sulphate; 100 mils Solution of Ammonia (10 per cent.); 900 mils Alcohol (60 per cent.)	Mix the Solution of Ammonia with the Alcohol, add the Quinine Sulphate, and shake until a clear solution results; set it aside for three days, and filter
Senegæ. Br.	200 Gm. Senega Root, No. 40 powder; Alcohol (60 per cent.) to make 1000 mils	Percolate the drug with the menstruum, after 24 hours maceration, to make 1000 mils
Sennæ Compositæ. Br.	200 Gm. Senna Leaves, No. 20 powder; 25 Gm. Caraway Fruit, No. 20 powder; 25 Gm. Coriander Fruit, No. 20 powder; 1000 mils Alcohol (45 per cent.)	Percolate the drugs with the Alcohol, after 24 hours maceration, to make 1000 mils
Stramonii. Br.	200 Gm. Stramonium Leaves, No. 20 powder; Alcohol (45 per cent.), enough to make 1000 mils	Percolate the drug with the Alcohol, after macerating 24 hours, to make 1000 mils

TINCTURA ACONITI. U. S. Tincture of Aconite
[Tr. Aconit. Aconiti Tinctura P. I.]

One hundred mils of Tincture of Aconite yields not less than 0.045 Gm. nor more than 0.055 Gm. of the ether-soluble alkaloids of aconite. If assayed biologically the minimum lethal dose should not be greater than 0.0004 mil for each gramme of body weight of guinea-pig.

	Metric	Old form
***Aconite**, in No. 60 powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of a menstruum prepared by mixing 7 volumes of alcohol and 3 volumes of water, to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding menstruum until the percolate measures 950 mils [old form about 30½ fl. oz.]. Assay a sample of this percolate as directed and from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloids in the remainder of the liquid and adjust the volume of the finished Tincture so that each 100 mils contains 0.05 Gm. of the ether-soluble alkaloids of aconite. (U. S. P. Type Process P.)

Assay.—Evaporate 150 mils of Tincture of Aconite at a temperature not exceeding 75° C. (167° F.), until it measures about 20 mils. Add 10 Gm. of purified saw-dust (see Reagents, Chapter LXII) to this liquid, incorporate it thoroughly and then continue the evaporation until the sawdust is dry. Transfer the impregnated sawdust to a 250-mil flask, add 150 mils of ether and proceed as directed in the assay under *Belladonnæ Radix*, third line of the Assay, modifying the process there given by using the ammonia water with a small quantity of distilled water to rinse out the dish in which the mixture was evaporated, and use ether only in the final extraction of the alkaloids.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 64.539 milligrammes of the ether-soluble alkaloids of aconite.

For an alternative method of assaying Tincture of Aconite, see Biological Assays (Chapter LXII).

In the U. S. P., 1890, Tincture of Aconite, each 100 mils represented 35 Gm. of drug, so that the tincture was three and one-half times stronger than the present official tincture.

Average dose.—5 minims (0.3 mil).

TINCTURA ALOES. U. S. Tincture of Aloes
[Tr. Aloes]

	Metric	Old form
***Aloes**, in No. 40 powder	**100 Gm.**	3 oz. av. 148 gr.
Glycyrrhiza, in No. 40 powder	**200 Gm.**	6 oz. av. 296 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Macerate the mixed drugs in a stoppered container, in a moderately warm place with 750 mils [old form 24 fl. oz.] of diluted alcohol. Continue the maceration with frequent agitation during three days or until the drug is practically extracted, transfer the mixture to a filter, and, when the liquid has drained off completely, gradually wash the residue on the filter with enough of the solvent to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process M.)

Average dose.—30 minims (2 mils).

TINCTURA ARNICÆ. U. S. Tincture of Arnica
[Tr. Arnic.]

	Metric	Old form
***Arnica**, in No. 20 powder	**200 Gm.**	6 oz. av. 296 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the drug with 500 mils [old form 1 pint] of diluted alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for twenty-four hours, then pack it with moderate pressure and allow the percolation to proceed slowly, pouring on additional diluted alcohol as needed. When the percolate measures 250 mils [old form 8 fl. oz.], stop the flow, macerate the drug for an additional twenty-four hours, and then continue the percolation until the total percolate measures 500 mils [old form 1 pint]. Again interrupt the percolation, macerate the drug for another twelve hours and afterwards collect an additional 250 mils [old form 8 fl. oz.] of percolate. Again macerate the drug for twelve hours and then allow the percolation to proceed slowly, pouring on sufficient diluted alcohol to make 1000 mils [old form 2 pints] of Tincture.

Average dose.—15 minims (1 mil).

TINCTURA ASAFŒTIDÆ. U. S. Tincture of Asafetida
[Tr. Asafœt.]

	Metric	Old form
***Asafetida**, bruised	**200 Gm.**	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	**1000 mils.**	2 pints

Macerate the drug in a stoppered container, in a moderately warm place with 750 mils [old form 24 fl. oz.] of alcohol. Continue the maceration with frequent agitation during three days or until the drug is practically extracted, transfer the mixture to a filter, and, when the liquid has drained off completely, gradually wash the residue on the filter with enough of the solvent to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process M.)

N. F. Preparation.—Mistura Magnesii, Asafœtidæ et Opii.

Average dose —15 minims (1 mil.)

TINCTURA AURANTII AMARI. U. S. **Tincture of Bitter Orange Peel**
[Tr. Aurant. Amar.]

	Metric	Old form
***Bitter Orange Peel,** in No. 40 powder.....	**200 Gm.**	6 oz. av. 296 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make.....	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of a menstruum prepared by mixing 3 volumes of alcohol and 2 volumes of water, to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the menstruum to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

N. F. Preparation.—Elixir Aurantii Amari.

Average dose.—1 fluidrachm (4 mils).

TINCTURA AURANTII DULCIS. U. S. **Tincture of Sweet Orange Peel**
[Tr. Aurant. Dulc.]

	Metric	Old form
***Sweet Orange Peel,** grated from the fresh fruit...	**500 Gm.**	16 oz. av. 302 gr.
Alcohol, a sufficient quantity,		
To make.....	**1000 mils**	2 pints

Macerate the drug in a stoppered container, in a moderately warm place with 750 mils [old form 24 fl. oz.] of alcohol. Continue the maceration with frequent agitation during three days or until the drug is practically extracted, transfer the mixture to a filter and, when the liquid has drained off completely, gradually wash the residue on the filter with enough of the solvent to make 1000 mils [old form 2 pints] of finished Tincture. Use purified cotton as the filtering medium. (U. S. P. Type Process M.)

U. S. P. Preparation.—Syrupus Aurantii.

N. F. Preparations.—Elixir Gentianæ Glycerinatum; Elixir Pepsini et Rennini Compositum; Elixir Taraxaci Compositum; Elixir Terpini Hydratis; Vinum Ferri; Vinum Ferri Amarum.

Average dose.—1 fluidrachm (4 mils).

TINCTURA BELLADONNÆ FOLIORUM. U. S. **Tincture of Belladonna Leaves**

[Tr. Bellad. Fol. BELLADONNÆ TINCTURA P. I.]

One hundred mils of Tincture of Belladonna Leaves yields not less than 0.027 Gm. nor more than 0.033 Gm. of the total alkaloids of belladonna leaves.

	Metric	Old form
***Belladonna Leaves**, in No. 60 powder	**100 Gm.**	3 oz. av. 148 gr.
Diluted Alcohol, a sufficient quantity,		
To make about	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of diluted alcohol to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding menstruum until the percolate measures 950 mils [old form about 30½ fl. oz.]. Assay a sample of this percolate as directed and from the alkaloidal content thus determined ascertain by calculation the amount of alkaloids in the remainder of the liquid and adjust the volume of the finished Tincture so that each 100 mils contains 0.03 Gm. of the total alkaloids of belladonna leaves. (U. S. P. Type Process P.)

Assay.—Evaporate 100 mils of Tincture of Belladonna Leaves on a water bath until it measures about 10 mils, transfer the evaporated liquid to a separator, and proceed as directed in the assay under *Fluidextractum Belladonnæ Radicis*, second line of the Assay, beginning with the words "add 10 mils," modifying the process there given by increasing the ammonia water to 5 mils, which, with about 5 mils of distilled water, is to be used in divided portions to rinse out the dish in which the mixture was evaporated; before titrating treat the residue twice with 5 mils of ether, evaporating to dryness each time.

Average dose.—12 minims (0.75 mil).

TINCTURA BENZOINI. U. S. Tincture of Benzoin [Tr. Benz.]

	Metric	Old form
***Benzoin**, in No. 40 powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Macerate the drug in a stoppered container, in a moderately warm place with 750 mils [old form 24 fl. oz.] of alcohol. Continue the maceration with frequent agitation during three days or until the drug is practically extracted, transfer the mixture to a filter, and, when the liquid has drained off completely, gradually wash the residue on the filter with enough of the solvent to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process M.)

N. F. Preparation.—Unguentum Picis Compositum.

Average dose.—15 minims (1 mil).

TINCTURA BENZOINI COMPOSITA. U. S. Compound Tincture of Benzoin [Tr. Benz. Co.]

	Metric	Old form
***Benzoin**, in No. 40 powder	**100 Gm.**	3 oz. av. 148 gr.
Aloes, in No. 40 powder	**20 Gm.**	292 gr.
Storax	**80 Gm.**	2 oz. av. 293 gr.
Balsam of Tolu	**40 Gm.**	1 oz. av. 147 gr.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Macerate the mixed drugs in a stoppered container, in a moderately warm place with 750 mils [old form 24 fl. oz.] of alcohol. Continue the maceration with frequent agitation during three days or until the drug is practically extracted, transfer the mixture to a filter, and, when the liquid has drained off completely, gradually wash the residue on the filter with enough of the solvent to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process M.)

Average dose.—30 minims (2 mils).

TINCTURA CALUMBÆ. U. S. Tincture of Calumba [Tr. Calumb.]

	Metric	Old form
***Calumba**, in No. 20 powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 3 volumes of alcohol and 2 volumes of water, to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the menstruum to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

Average dose.—1 fluidrachm (4 mils).

TINCTURA CANNABIS. U. S. Tincture of Cannabis [Tr. Cannab. Tinctura Cannabis Indicæ, U. S. P. VIII]

When assayed biologically Tincture of Cannabis produces incoördination when administered to dogs in a dose of not more than 0.3 mil per kilogramme of body weight.

	Metric	Old form
***Cannabis**, in No. 40 powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol, a sufficient quantity,		
To make about	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of alcohol to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding menstruum

until the percolate measures 950 mils [old form about 30½ fl. oz.]. Assay a sample of this product as directed below and adjust the volume of the finished Tincture to conform with the above biological standard. (U. S. P. Type Process P.)

Assay.—Proceed as directed under Biological Assays (Chapter LXII).
N. F. Preparation.—Mistura Chloroformi et Morphinæ Composita.

Average dose.—12 minims (0.75 mil).

TINCTURA CANTHARIDIS. U. S. Tincture of Cantharides

[Tr. Canthar. CANTHARIDIS TINCTURA P. I.]

	Metric	Old form
***Cantharides**, in No. 60 powder	**100 Gms.**	3 oz. av. 148 gr.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Place the cantharides in a strong tin container, which has a capacity of not less than 2000 mils [old form 4 pints]. Add 1000 mils [old form 2 pints] of alcohol, agitate the mixture thoroughly, and insert in the opening of the can a tightly fitting cork through which passes a glass tube, not less than 6.4 mm. (¼ inch) in diameter and 75 cm. (30 inches) in length. Place the can in a water bath and maintain a temperature of from 50° to 55° C. (122° to 131° F.) for twenty-four hours with frequent agitation. Then remove it from the water bath, pour the contents into a cylindrical percolator, in the neck of which has been placed a pledget of purified cotton, allow the percolation to proceed, and, after the liquid has disappeared from the surface and ceased to drop from the percolator, gradually pour on sufficient alcohol to make 1000 mils [old form 2 pints] of Tincture.

Average dose.—1½ minims (0.1 mil).

TINCTURA CAPSICI. U. S. Tincture of Capsicum

[Tr. Capsic.]

	Metric	Old form
***Capsicum**, in No. 50 powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 95 volumes of alcohol and 5 volumes of water, to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of

the menstruum to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

N. F. Preparations.—Mistura Chloroformi et Morphinæ Composita; Mistura Opii et Chloroformi Composita; Mistura Opii et Rhei Composita.

Average dose.—8 minims (0.5 mil).

TINCTURA CARDAMOMI. U. S. **Tincture of Cardamom**
[Tr. Cardam.]

	Metric	Old form
***Cardamom Seed,** in No. 40 powder	**150 Gm.**	5 oz. av. 3 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of diluted alcohol to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the menstruum to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

N. F. Preparation.—Vinum Rhei Compositum.

Average dose.—30 minims (2 mils).

TINCTURA CARDAMOMI COMPOSITA. U. S. **Compound Tincture of Cardamom**
[Tr. Cardam. Co.]

	Metric	Old form
***Cardamom Seed,** in No. 40 powder	**20 Gm.**	292 gr.
Saigon Cinnamon, in No. 60 powder	**25 Gm.**	365 gr.
Caraway, in No. 40 powder	**12 Gm.**	175 gr.
Cochineal, in No. 60 powder	**5 Gm.**	73 gr.
Glycerin,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Macerate the drug or mixed drugs in a stoppered container, in a moderately warm place with 750 mils [old form 24 fl. oz.] of a menstruum, prepared by mixing 50 mils [old form 1 fl. oz. 288 minims] of glycerin and 950 mils [old form 30 fl. oz. 192 minims] of diluted alcohol. Continue the maceration with frequent agitation during three days or until the drug is practically extracted, transfer the mixture to a filter, and, when the liquid has drained off completely, gradually wash the residue on the filter, first with the remainder of the solvent prepared as directed above, and then with enough diluted alcohol to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process M.)

N. F. Preparations.—Elixir Gentianæ Glycerinatum; Elixir Taraxaci Compositum; Elixir Viburni Prunifolii; Liquor Strychninæ Acetatis; Syrupus Eriodictyi Aromaticus.

Average dose.—1 fluidrachm (4 mils).

TINCTURA CINCHONÆ. U. S. Tincture of Cinchona
[Tr. Cinch.]

One hundred mils of Tincture of Cinchona yields not less than 0.8 Gm. nor more than 1 Gm. of the alkaloids of cinchona.

	Metric	Old form
***Cinchona**, in No. 40 powder	**200 Gm.**	6 oz. av. 296 gr.
Glycerin,		
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 75 mils [old form 2 fl. oz. 192 minims] of glycerin, 675 mils [old form 21 fl. oz. 288 minims] of alcohol and 250 mils [old form 8 fl. oz.] of water, to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding first the remainder of the menstruum prepared as directed above, and then a mixture of 2 volumes of alcohol and 1 volume of water until the percolate measures 950 mils [old form about 30½ fl. oz.]. Assay a sample of this percolate as directed and from the alkaloidal content thus determined ascertain by calculation the amount of alkaloids in the remainder of the liquid and adjust the volume of the finished Tincture so that each 100 mils contains 0.9 Gm. of the alkaloids of cinchona. (U. S. P. Type Process P.)

Assay.—Evaporate 25 mils of Tincture of Cinchona on a water bath until it measures about 15 mils, add 10 Gm. of purified sawdust (see Reagents, Chapter LXII), incorporate this thoroughly and then continue the evaporation at a temperature not exceeding 80° C. (176° F.) until it is dry. Transfer the impregnated sawdust to a 500-mil flask, and proceed as directed in the assay under *Cinchona*, third line of the Assay, modifying the process there given by increasing the ammonia water to 10 mils and using this in divided portions to rinse the dish in which the mixture was evaporated; then add the rinsings to the flask.

Average dose.—1 fluidrachm (4 mils).

TINCTURA CINCHONÆ COMPOSITA. U. S. Compound Tincture of Cinchona
[Tr. Cinch. Co.]

One hundred mils of Compound Tincture of Cinchona yields not less than 0.4 Gm. nor more than 0.5 Gm. of the alkaloids of cinchona.

	Metric	Old form
***Red Cinchona**, in No. 40 powder	**100 Gm.**	3 oz. av. 148 gr.
Bitter Orange Peel, in No. 40 powder	**80 Gm.**	2 oz. av. 293 gr.
Serpentaria, in No. 60 powder	**20 Gm.**	292 gr.
Glycerin,		
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	2 pints

Moisten the mixed drugs with a sufficient quantity of a menstruum, prepared by mixing 75 mils [old form 2 fl. oz. 192 minims] of glycerin, 675 mils [old form 21 fl. oz. 288 minims] of alcohol and 250 mils [old

form 8 fl. oz.] of water, to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding first the remainder of the menstruum prepared as directed above, and then a mixture of 2 volumes of alcohol and 1 volume of water, until the percolate measures 950 mils [old form about 30½ fl. oz.]. Assay a sample of this percolate as directed and from the alkaloidal content thus determined ascertain by calculation the amount of alkaloids in the remainder of the liquid and adjust the volume of the finished Tincture so that each 100 mils contains 0.45 Gm. of the alkaloids of cinchona. (U. S. P. Type Process P.)

Assay.—Proceed as directed in the assay under *Tinctura Cinchonæ*, modifying the process there given by using 50 mils of the Compound Tincture instead of 25 mils of the tincture there directed.

N. F. Preparation.—Gargarisma Guaiaci Composita.

Average dose.—1 fluidrachm (4 mils).

TINCTURA CINNAMOMI. U. S. Tincture of Cinnamon
[Tr. Cinnam.]

	Metric	Old form
***Saigon Cinnamon,** in No. 50 powder.....	**200 Gm.**	6 oz. av. 296 gr.
Glycerin,		
Alcohol,		
Water, each, a sufficient quantity,		
To make.....	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 75 volumes of glycerin, 675 volumes of alcohol, and 250 volumes of water, to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the menstruum to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

N. F. Preparations.—Elixir Taraxaci Compositum; Mistura Rhei Alkalina.

Average dose.—30 minims (2 mils).

TINCTURA COLCHICI SEMINIS. U. S. Tincture of Colchicum Seed
[Tr. Colch. Sem. Colchici Tinctura P. I.]

One hundred mils of Tincture of Colchicum Seed yields not less than 0.036 Gm. nor more than 0.044 Gm. of colchicine.

	Metric	Old form
***Colchicum Seed,** in No. 50 powder.....	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make about.....	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 3 volumes of alcohol and 2 volumes of water, to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding menstruum until the percolate measures 950 mils [old form about 30½ fl. oz.]. Assay a sample of this percolate as directed and from the alkaloidal content thus determined ascertain by calculation the amount of alkaloids in the remainder of the liquid and adjust the volume of the finished Tincture so that each 100 mils contains 0.04 Gm. of colchicine. (U. S. P. Type Process P.)

Assay.—Evaporate 150 mils of Tincture of Colchicum Seed on a water bath to about 20 mils, transfer it to a 50-mil graduated flask and rinse the evaporating dish with about 10 mils of distilled water, in divided portions. Then add 10 mils of solution of lead subacetate, shake the mixture thoroughly, add enough distilled water to make 50 mils and pour this into a 500-mil flask. Now add 250 mils of recently boiled distilled water, using part of the water to rinse the 50-mil flask, and proceed as directed in the assay under *Colchici Semen*, fifth line of the Assay, beginning with the words "filter off 200 mils."

Average dose.—30 minims (2 mils).

TINCTURA DIGITALIS. U. S. Tincture of Digitalis

[Tr. Digit. DIGITALIS TINCTURA P. I.]

If assayed biologically the minimum lethal dose should not be greater than 0.006 mil of the Tincture, or the equivalent in Tincture of 0.0000005 Gm. of ouabain, for each gramme of body weight of frog.

	Metric	Old form
***Digitalis,** in No. 60 powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of menstruum, prepared by mixing 3 volumes of alcohol, and 1 volume of water, to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the menstruum to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

Assay.—For a method of assaying Tincture of Digitalis see Biological Assays (Chapter LXII).

Average dose.—8 minims (0.5 mil).

TINCTURA FERRI CHLORIDI. U. S. Tincture of Ferric Chloride [Tr. Ferr. Chlor.]

A hydro-alcoholic solution containing ferric chloride [$FeCl_3 = 162.22$] (about 13 per cent.), corresponding to not less than 4.48 per cent. of Fe. Protect Tincture of Ferric Chloride from light.

	Metric	Old form
***Solution of Ferric Chloride**	**350 mils**	22 fl. oz. 3 fl. dr.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	4 pints

Mix the solution with enough alcohol to make 1000 mils [old form 4 pints], then transfer the Tincture to an amber-colored, glass-stoppered bottle and keep it for at least three months before dispensing.

(For tests and comments see Part III.)

U. S. P. Preparation.—Liquor Ferri et Ammonii Acetatis.

Average dose.—8 minims (0.5 mil).

TINCTURA GAMBIR COMPOSITA. U. S. Compound Tincture of Gambir [Tr. Gambir Co. Compound Tincture of Pale Catechu]

	Metric	Old form
***Gambir,** in No. 50 powder	**50 Gm.**	1 oz. av. 293 gr.
Saigon Cinnamon, in No. 50 powder	**25 Gm.**	365 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Macerate the mixed drugs in a stoppered container, in a moderately warm place with 750 mils [old form 24 fl. oz.] of diluted alcohol. Continue the maceration with frequent agitation during three days or until the drug is practically extracted, transfer the mixture to a filter, and, when the liquid has drained off completely, gradually wash the residue on the filter with enough of the solvent to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process M.)

N. F. Preparation.—Tinctura Pectoralis.

Average dose.—1 fluidrachm (4 mils).

TINCTURA GELSEMII. U. S. Tincture of Gelsemium [Tr. Gelsem.]

	Metric	Old form
***Gelsemium,** in No. 60 powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 65 volumes of alcohol and 35 volumes of water, to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum

to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the menstruum to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

Average dose.—4 minims (0.25 mil).

TINCTURA GENTIANÆ COMPOSITA. U. S. **Compound Tincture of Gentian**

[Tr. Gentian. Co.]

	Metric	Old form
***Gentian,** in No. 40 powder	**100 Gm.**	3 oz. av. 148 gr.
Bitter Orange Peel, in No. 40 powder	**40 Gm.**	1 oz. av. 147 gr.
Cardamom Seed, in No. 40 powder	**10 Gm.**	146 gr.
Glycerin,		
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the mixed drugs with a sufficient quantity of a menstruum, prepared by mixing 100 mils [old form 3 fl. oz. 96 minims] of glycerin, 500 mils [old form 1 pint] of alcohol and 400 mils [old form 12 fl. oz. 384 minims] of water, to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding first the remainder of the menstruum prepared as directed above and then sufficient diluted alcohol to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

Average dose.—1 fluidrachm (4 mils).

TINCTURA GUAIACI. U. S. **Tincture of Guaiac**

[Tr. Guaiac.]

	Metric	Old form
***Guaiac,** in No. 40 powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Macerate the drug in a stoppered container, in a moderately warm place with 750 mils [old form 24 fl. oz.] of alcohol. Continue the maceration with frequent agitation during three days or until the drug is practically extracted, transfer the mixture to a filter, and, when the liquid has drained off completely, gradually wash the residue on the filter with enough of the solvent to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process M.)

N. F. Preparation.—Mistura Guaiaci.

Average dose.—1 fluidrachm (4 mils).

TINCTURA GUAIACI AMMONIATA. U. S. **Ammoniated Tincture of Guaiac**

[Tr. Guaiac. Ammon.]

	Metric	Old form
***Guaiac,** in No. 40 powder	200 Gm.	6 oz. av. 296 gr.
Aromatic Spirit of Ammonia, a sufficient quantity,		
To make	1000 mils	2 pints

Macerate the drug in a stoppered container, in a moderately warm place with 750 mils [old form 24 fl. oz.] of aromatic spirit of ammonia. Continue the maceration with frequent agitation during three days or until the drug is practically extracted, transfer the mixture to a filter, and, when the liquid has drained off completely, gradually wash the residue on the filter with enough of the solvent to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process M.)

N. F. Preparation.—Gargarisma Guaiaci Composita.

Average dose.—30 minims (2 mils).

TINCTURA HYDRASTIS. U. S. **Tincture of Hydrastis**

[Tr. Hydrast. TINCTURE OF GOLDEN SEAL]

One hundred mils of Tincture of Hydrastis yields not less than 0.36 Gm. nor more than 0.44 Gm. of the ether-soluble alkaloids of hydrastis.

	Metric	Old form
***Hydrastis,** in No. 60 powder	200 Gm.	6 oz. av. 296 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	1000 mils	2 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 2 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding menstruum until the percolate measures 950 mils [old form about 30½ fl. oz.]. Assay a sample of this percolate as directed and from the alkaloidal content thus determined ascertain by calculation the amount of alkaloids in the remainder of the liquid and adjust the volume of the finished Tincture so that each 100 mils contains 0.4 Gm. of the ether-soluble alkaloids of hydrastis. (U. S. P. Type Process P.)

Assay.—Evaporate 50 mils of Tincture of Hydrastis on a water bath until it measures about 10 mils, transfer the evaporated liquid to a separator, and proceed as directed in the assay under *Fluidextractum Belladonnæ Radicis*, second line of the Assay, beginning with the words "add 10 mils," modifying the process there given by using the ammonia water with about 5 mils of distilled water, in divided portions, to rinse out the dish in which the Tincture was evaporated. Use only ether as the immiscible solvent throughout the assay and dry the residue at 100° C. (212° F.), to constant weight, instead of titrating it. The weight of the residue represents the amount of ether-soluble alkaloids in 50 mils of Tincture of Hydrastis.

Average dose.—1 fluidrachm (4 mils).

TINCTURA HYOSCYAMI. U. S. Tincture of Hyoscyamus

[Tr. Hyosc. Tincture of Henbane Hyoscyami tinctura P. I.]

One hundred mils of Tincture of Hyoscyamus yields not less than 0.0055 Gm. nor more than 0.0075 Gm. of the alkaloids of hyoscyamus.

	Metric	Old form
***Hyoscyamus,** in No. 60 powder	**100 Gm.**	3 oz. av. 148 gr.
Diluted Alcohol, a sufficient quantity,		
To make about	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of diluted alcohol to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding menstruum until the percolate measures 950 mils [old form about 30½ fl. oz.]. Assay a sample of this percolate as directed and from the alkaloidal content thus determined ascertain by calculation the amount of alkaloids in the remainder of the liquid and adjust the volume of the finished Tincture so that each 100 mils contains 0.0065 Gm. of the alkaloids of hyoscyamus. (U. S. P. Type Process P.)

Assay.—Evaporate 250 mils of Tincture of Hyoscyamus on a water bath to about 10 mils, transfer the evaporated liquid to a separator, and proceed as directed in the assay under *Fluidextractum Belladonnæ Radicis*, second line of the Assay, beginning with the words "add 10 mils," modifying the process there given by increasing the ammonia water to 5 mils, which, with 5 mils of distilled water, is to be used, in divided portions, to rinse the dish in which the Tincture was evaporated; before titrating treat the residue twice with 5 mils of ether, evaporating to dryness each time.

Average dose.—30 minims (2 mils).

TINCTURA IODI. U. S. Tincture of Iodine

[Tr. Iodi]

An alcoholic solution of iodine and potassium iodide. One hundred mils contains not less than 6.5 Gm. nor more than 7.5 Gm. of I (126.92) and not less than 4.5 Gm. nor more than 5.5 Gm. of KI (166.02).

	Metric	Old form
***Iodine**	**70 Gm.**	255 gr.
Potassium Iodide	**50 Gm.**	182 gr.
Distilled Water	**50 mils**	192 min.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	8 fl. oz.

Dissolve the potassium iodide in the distilled water contained in a bottle graduated to 1000 mils [old form 8 fl. oz.]; add the iodine and agitate the mixture until solution is effected. Then add sufficient alcohol to make 1000 mils [old form 8 fl. oz.] of Tincture, and mix thoroughly.

Assay for Potassium Iodide.—Evaporate 10 mils of Tincture of Iodine in a tared porcelain dish on a water bath and gently heat the residue over a Bunsen flame to volatilize the iodine; it leaves a residue weighing not less than 0.45 Gm. nor more than 0.55 Gm., which corresponds to the identity tests under *Potassii Iodidum*.

Assay for Iodine.—Mix 5 mils of the Tincture with 25 mils of distilled water and titrate the solution with tenth-normal sodium thiosulphate V.S.; it requires not less than 25.6 mils nor more than 29.6 mils of tenth-normal sodium thiosulphate V.S. for complete decoloration.

Each mil of tenth-normal sodium thiosulphate V.S. corresponds to 0.012692 Gm. of I.

The water has been added to this formula to assist in the solution of the iodine, which, in the presence of the potassium iodide, is rendered readily soluble. The potassium iodide was not introduced, however, to increase the iodine solubility, although advantage is taken of its presence to aid in the rapidity of solution, but it is added as a preservative and when present prevents the rapid change of iodine to hydriodic acid. It is, therefore, important not to omit it from the formula.

Average dose.—1½ minims (0.1 mil).

TINCTURA KINO. U. S. Tincture of Kino
[Tr. Kino]

	Metric	Old form
***Kino**	**100 Gm.**	365 gr.
Water, a sufficient quantity.		
To make	**1000 mils**	8 fl. oz.

Place the kino in a capacious flask and pour on it 500 mils [old form 4 fl. oz.] of boiling water. Agitate the mixture thoroughly, then heat it on a water bath, containing boiling water, for one hour, shaking it frequently. Allow the liquid to cool, add enough recently boiled water to make the product measure 500 mils [old form 4 fl. oz.] and then add 500 mils [old form 4 fl. oz.] of alcohol. Stopper the flask, set it aside in a cool place for twenty-four hours and then decant the mixture through cheesecloth. Preserve it in a cool and dark place, in small bottles, tightly corked.

N. F. Preparation.—Tinctura Kino et Opii Composita.

Average dose.—1 fluidrachm 4 (mils).

TINCTURA LACTUCARII. U. S. Tincture of Lactucarium
[Tr. Lactucar.]

	Metric	Old form
***Lactucarium**	**500 Gm.**	16 oz. av. 302 gr.
Glycerin	**250 mils**	8 fl. oz.
Alcohol,		
Purified Petroleum Benzin,		
Diluted Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Beat the lactucarium with clean sand, in an iron mortar, to a coarse powder, and then transfer it to a bottle; add 2000 mils [old form 4 pints] of purified petroleum benzin, cork the bottle tightly, and set it aside for forty-eight hours, frequently agitating the mixture. Pour the mixture on a double filter, cover the funnel, and, when the liquid has passed through the filter, wash the residue gradually with 1500 mils [old form 3 pints] of purified petroleum benzin, and then allow the lactucarium

to dry by exposing it to a current of air. When it is dry and free from the odor of benzin, reduce it to a powder, using more sand, if necessary, and pack it moderately in a conical percolator. Mix the glycerin with 250 mils [old form 8 fl. oz.] of water and 500 mils [old form 1 pint] of alcohol, and gradually pour this mixture on the powder. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding first the remainder of the menstruum and then diluted alcohol, until the drug is exhausted. Reserve the first 750 mils [old form 24 fl. oz.] of the percolate, evaporate the remainder on a water bath at a temperature not exceeding 70° C. (158° F.) until it measures 250 mils [old form 8 fl. oz.] and mix this with the reserved portion. Filter the mixed liquids and wash the filter with sufficient diluted alcohol to make 1000 mils [old form 2 pints] of Tincture.

U. S. P. Preparation.—Syrupus Lactucarii.

Average dose.—30 minims (2 mils).

TINCTURA LAVANDULÆ COMPOSITA. U. S. Compound Tincture of Lavender

[Tr. Lavand. Co. Compound Spirit of Lavender]

	Metric	Old form
***Oil of Lavender**	8 mils	123 min.
Oil of Rosemary	2 mils	31 min.
Saigon Cinnamon, in No. 50 powder	20 Gm.	292 gr.
Clove, in No. 50 powder	5 Gm.	73 gr.
Myristica, in No. 50 powder	10 Gm.	146 gr.
Red Saunders, in No. 50 powder	10 Gm.	146 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 mils	2 pints

Macerate the mixed drugs in a stoppered container, in a moderately warm place with 750 mils [old form 24 fl. oz.] of a menstruum, prepared by mixing 750 mils [old form 24 fl. oz.] of alcohol, in which the oils have been dissolved, and 250 mils [old form 8 fl. oz.] of water. Continue the maceration with frequent agitation during three days or until the drug is practically extracted, transfer the mixture to a filter, and, when the liquid has drained off completely, gradually wash the residue on the filter with first the remainder of the menstruum prepared as directed above, and then with enough of a mixture of 3 volumes of alcohol and 1 volume of water to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process M.)

U. S. P. Preparation.—Liquor Potassii Arsenitis.

N. F. Preparations.—Mistura Camphoræ Aromatica; Mistura Copaibæ; Mistura Copaibæ et Opii.

Average dose.—30 minims (2 mils).

TINCTURA LIMONIS CORTICIS. U. S. Tincture of Lemon Peel

[Tr. Limon. Cort.]

	Metric	Old form
***Lemon Peel**, grated from the fresh fruit	500 Gm.	16 oz. av. 302 gr.
Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Macerate the drug in a stoppered container, in a moderately warm place with 750 mils [old form 24 fl. oz.] of alcohol. Continue the maceration with frequent agitation during three days or until the drug is practically extracted, transfer the mixture to a filter, and, when the liquid has drained off completely, gradually wash the residue on the filter with enough of the solvent to make 1000 mils [old form 2 pints] of finished Tincture. Use purified cotton as the filtering medium. (U. S. P. Type Process M.)

U. S. Preparation.—Syrupus Acidi Citrici.

N. F. Preparations.—Emulsum Petrolati; Syrupus Calcii Hydrochlorophosphatis.

TINCTURA LOBELIÆ. U. S. Tincture of Lobelia

[Tr. Lobel. Lobeliæ Tinctura P. I.]

	Metric	Old form
***Lobelia,** in No. 50 powder	**100 Gm.**	3 oz. av. 148 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of diluted alcohol to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the menstruum to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

Average dose.—15 minims (1 mil.)

TINCTURA MOSCHI. U. S. Tincture of Musk

[Tr. Mosch.]

	Metric	Old form
***Musk**	**5 Gm.**	91 gr.
Alcohol	**45 mils**	1 fl. oz. 6 fl. dr.
Water	**45 mils**	1 fl. oz. 6 fl. dr.
Diluted Alcohol, a sufficient quantity,		
To make	**100 mils**	4 fl. oz.

Triturate the musk with the water gradually added until a smooth mixture is obtained; transfer this to a bottle and allow the mixture to macerate for twenty-four hours; then add the alcohol and macerate the mixture for six days, with occasional agitation. Transfer this mixture to a plain paper filter, and, when the liquid has drained off completely, wash the residue on the filter with sufficient diluted alcohol to make 100 mils [old form 4 fl. oz.] of Tincture.

Average dose.—1 fluidrachm (4 mils).

TINCTURA MYRRHÆ. U. S. Tincture of Myrrh

[Tr. Myrrh.]

	Metric	Old form
***Myrrh,** in moderately coarse powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Macerate the drug in a stoppered container, in a moderately warm place with 750 mils [old form 24 fl. oz.] of alcohol. Continue the mac-

eration with frequent agitation during three days or until the drug is practically extracted, transfer the mixture to a filter, and, when the liquid has drained off completely, gradually wash the residue on the filter with enough of the solvent to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process M.)

Average dose.—15 minims (1 mil).

TINCTURA NUCIS VOMICÆ. U. S. Tincture of Nux Vomica
[Tr. Nuc. Vom. Strychni Tinctura P. I.]

One hundred mils of Tincture of Nux Vomica yields not less than 0.237 Gm. nor more than 0.263 Gm. of the alkaloids of nux vomica.

	Metric	Old form
***Nux Vomica**, in No. 40 powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 3 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding menstruum until the percolate measures 950 mils [old form about 30½ fl. oz.]. Assay a sample of this percolate as directed and from the alkaloidal content thus determined ascertain by calculation the amount of alkaloids in the remainder of the liquid and adjust the volume of the finished Tincture so that each 100 mils contains 0.25 Gm. of the alkaloids of nux vomica. The rate of flow for the percolate should not exceed ten drops per minute. (U. S. P. Type Process P.)

Assay.—Evaporate 100 mils of Tincture of Nux Vomica on a water bath until it measures about 10 mils, transfer the evaporated liquid to a separator, and proceed as directed in the assay under *Fluidextractum Belladonnæ Radicis*, second line of the Assay, beginning with the words "add 10 mils," modifying the process there given by using 5 mils of ammonia water with a little distilled water, in divided portions, to rinse the dish in which the Tincture was evaporated and by dissolving the residue in 10 mils of tenth-normal sulphuric acid V.S. instead of 5 mils.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 36.4 milligrammes of the alkaloids of nux vomica.

N. F. Preparation.—Elixir Phosphori et Nucis Vomicæ.

Average dose.—8 minims (0.5 mil).

TINCTURA OPII. U. S. Tincture of Opium
[Tr. Opii. Laudanum Opii Tinctura P. I.]

One hundred mils of Tincture of Opium yields not less than 0.95 Gm. nor more than 1.05 Gm. of anhydrous morphine.

	Metric	Old form
***Granulated Opium**	**100 Gm.**	3 oz. av. 148 gr
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make about	**1000 mils**	2 pints

Heat 400 mils [old form about 13 fl. oz.] of water to boiling, and pour it on the granulated opium contained in a tared vessel, and weigh; then stir the mixture occasionally during twelve hours, restore the original weight by the addition of water, add 400 mils [old form about 13 fl. oz.] of alcohol, pour the mixture into a bottle, and continue the maceration for forty-eight hours, occasionally shaking the mixture. Then transfer the mixture to a percolator, return the first portion of the percolate until it runs through clear, and, when the original menstruum has ceased to drop, continue the percolation slowly, gradually adding sufficient diluted alcohol to make the percolate measure 950 mils [old form about 30½ fl. oz.]. Assay a portion of this percolate, as directed below, and, from the morphine content thus determined, ascertain by calculation the amount of anhydrous morphine in the remainder of the liquid and adjust the volume of the finished Tincture so that each 100 mils contains 1 Gm. of anhydrous morphine.

Assay.—Evaporate 80 mils of Tincture of Opium on a water bath until the alcohol is all removed. Then proceed as directed in the assay under *Opium*, thirteenth line of the Assay, beginning with the word "Transfer." The result of the assay indicates the amount of morphine obtained from 40 mils of the Tincture of Opium.

N. F. Preparations.—Linimentum Opii Compositum; Lotio Plumbi et Opii; Mistura Camphoræ Acida; Mistura Carminativa; Mistura Copaibæ et Opii; Mistura Magnesiæ, Asafœtidæ et Opii; Mistura Opii et Chloroformi Composita; Mistura Opii et Rhei Composita; Mistura Opii et Sassafras; Tinctura Kino et Opii Composita; Tinctura Pectoralis.

Average dose.—8 minims (0.5 mil).

TINCTURA OPII CAMPHORATA. U. S. Camphorated Tincture of Opium

[Tr. Opii Camph. Paregoric Opii Tinctura Benzoici P. I.]

	Metric	Old form
***Powdered Opium**	4 Gm.	58 gr.
Benzoic Acid	4 Gm.	58 gr.
Camphor	4 Gm.	58 gr.
Oil of Anise	4 mils	1 fl. dr.
Glycerin,		
Diluted Alcohol, each, a sufficient quantity,		
To make	1000 mils	2 pints

Macerate the mixed drugs in a stoppered container, in a moderately warm place with 750 mils [old form 24 fl. oz.] of a menstruum, prepared by mixing 40 mils [old form 1 fl. oz. 134 min.] of glycerin and 950 mils [old form 30 fl. oz. 192 min.] of diluted alcohol. Continue the maceration with frequent agitation during three days or until the drug is practically extracted, transfer the mixture to a filter, and, when the liquid has drained off completely, gradually wash the residue on the filter with enough of the solvent, first using the remainder of the menstruum prepared, and then diluted alcohol, to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process M.)

This Tincture contains 0.4 Gm. of Powdered Opium (0.041 Gm. of anhydrous morphine) in each 100 mils, corresponding to 1⅘ grains of Powdered Opium in each fluidounce.

U. S. P. Preparation.—Mistura Glycyrrhizæ Composita.

N. F. Preparation.—Mistura Pectoralis, Stokes.

Average dose.—1 fluidrachm (4 mils).

TINCTURA OPII DEODORATI. U. S. Tincture of Deodorized Opium [Tr. Opii Deod.]

One hundred mils of Tincture of Deodorized Opium yields not less than 0.95 Gm. nor more than 1.05 Gm. of anhydrous morphine.

	Metric	Old form
*Granulated Opium	100 Gm.	3 oz. av. 148 gr.
Purified Petroleum Benzin	75 mils	2 fl. oz. 3 fl. dr.
Alcohol	200 mils	6 fl. oz. 3 fl. dr.
Water, a sufficient quantity,		
To make about	1000 mils	2 pints

Heat 500 mils [old form 1 pint] of water to boiling, and pour it on the granulated opium contained in a suitable vessel, stirring the mixture frequently during twenty-four hours. Then transfer the mixture to a percolator, return the first portion of the percolate until it runs through clear, and, when the original menstruum has ceased to drop, continue the percolation slowly, gradually adding water until the opium is practically exhausted.

Concentrate the percolate, by evaporation on a water bath, until it measures 150 mils [old form 4¾ fl. oz.], cool, transfer it to a bottle, add 65 mils [old form 2 fl. oz.] of purified petroleum benzin, stopper, and shake the mixture frequently during ten minutes. Separate the benzin layer and repeat the shaking out with the remainder of the purified petroleum benzin, carefully and completely separating the benzin layer each time. Allow the aqueous liquid to evaporate spontaneously in a warm place until the odor of benzin has almost disappeared, remove the last traces by cautiously heating on a water bath and then add 600 mils [old form about 20 fl. oz.] of water. Filter the liquid, add the alcohol and wash the residue on the filter with sufficient water to make the product measure 950 mils [old form about 30½ fl. oz.].

Assay a portion of this filtrate as directed below, and, from the morphine content thus determined, ascertain by calculation the amount of anhydrous morphine in the remainder of the liquid and adjust the volume of the finished Tincture so that each 100 mils contains 1 Gm. of anhydrous morphine.

Assay.—Proceed as directed in the assay under *Tinctura Opii.*

N. F. Preparation.—Tinctura Ipecacuanhæ et Opii.

Average dose.—8 minims (0.5 mil).

TINCTURA PHYSOSTIGMATIS. U. S. Tincture of Physostigma [Tr. Physostig. Tincture of Calabar Bean]

One hundred mils of Tincture of Physostigma yields not less than 0.013 Gm. nor more than 0.017 Gm. of the alkaloids of physostigma.

	Metric	Old form
*Physostigma, in No. 50 powder	100 Gm.	3 oz. av. 148 gr.
Alcohol, a sufficient quantity,		
To make about	1000 mils	2 pints

Moisten the powdered drug with a sufficient quantity of alcohol to render it evenly and distinctly damp, transfer it to a percolator, and,

without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding menstruum until the percolate measures 950 mils [old form about 30½ fl. oz.]. Assay a sample of this percolate as directed and from the alkaloidal content thus determined ascertain by calculation the amount of alkaloids in the remainder of the liquid and adjust the volume of the finished Tincture so that each 100 mils contains 0.015 Gm. of the alkaloids of physostigma. (U. S. P. Type Process P.)

Assay.—Evaporate 150 mils of Tincture of Physostigma on a water bath until it measures about 20 mils, add 10 Gm. of sawdust purified (see Reagents, Chapter LXII) to the liquid and incorporate it thoroughly. Continue the evaporation on a water bath until the mixture is dry, then transfer the impregnated sawdust to a 250-mil flask, and proceed as directed in the assay under *Physostigma*, second line of Assay, beginning with the words "and add 150 mils of ether," modifying the process there given by using the solution of sodium bicarbonate, in divided portions, to rinse the evaporating dish.

Average dose.—15 minims (1 mil).

TINCTURA PYRETHRI. U. S. Tincture of Pyrethrum

[Tr. Pyreth.—Tincture of Pellitory]

	Metric	Old form
***Pyrethrum**, in No. 50 powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of alcohol to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the menstruum to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

TINCTURA QUASSIÆ. U. S. Tincture of Quassia

[Tr. Quas.]

	Metric	Old form
***Quassia**, in No. 50 powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 1 volume of alcohol and 2 volumes of water, to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to

saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the menstruum to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

Average dose.—30 minims (2 mils).

TINCTURA RHEI. U. S. Tincture of Rhubarb
[Tr. Rhei]

	Metric	Old form
***Rhubarb**, in No. 40 powder	**200 Gm.**	6 oz. av. 296 gr.
Cardamom Seed, in No. 40 powder	**30 Gm.**	1 oz. av.
Glycerin,		
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the mixed drugs with a sufficient quantity of a menstruum, prepared by mixing 100 mils [old form 3 fl. oz. 96 minims] of glycerin, 500 mils [old form 1 pint] of alcohol and 400 mils [old form 12 fl. oz. 384 minims] of water, to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding first the remainder of the menstruum prepared as directed above and then sufficient diluted alcohol to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

N. F. Preparation.—Mistura Opii et Rhei Composita.

Average dose.—1 fluidrachm (4 mils).

TINCTURA RHEI AROMATICA. U. S. Aromatic Tincture of Rhubarb
[Tr. Rhei Arom.]

	Metric	Old form
***Rhubarb**, in No. 40 powder	**200 Gm.**	6 oz. av. 296 gr.
Saigon Cinnamon, in No. 40 powder	**40 Gm.**	1 oz. av. 147 gr.
Clove, in No. 40 powder	**40 Gm.**	1 oz. av. 147 gr.
Myristica, in No. 40 powder	**20 Gm.**	292 gr.
Glycerin,		
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the mixed drugs with a sufficient quantity of a menstruum, prepared by mixing 100 mils [old form 3 fl. oz. 96 minims] of glycerin, 500 mils [old form 1 pint] of alcohol, and 400 mils [old form 12 fl. oz. 384 minims] of water, to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of

the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding first the remainder of the menstruum prepared as directed above and then sufficient diluted alcohol to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

U. S. P. Preparation—Syrupus Rhei Aromaticus.

Average dose—30 minims (2 mils).

TINCTURA SANGUINARIÆ. U. S. Tincture of Sanguinaria
[Tr. Sanguin. Tincture of Bloodroot]

	Metric	Old form
***Sanguinaria,** in No. 60 powder	**100 Gm.**	3 oz. av. 148 gr.
Hydrochloric Acid	**10 mils**	2½ fl. dr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix 600 mils [old form about 19 fl. oz.] of alcohol with 400 mils [old form about 13 fl. oz.] of water. Moisten the drug with a mixture of the hydrochloric acid and 30 mils [old form 1 fl. oz.] of this menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well-covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum, made of alcohol and water, in the same proportion as before, to make 1000 mils [old form 2 pints] of Tincture.

Average dose.—15 minims (1 mil).

TINCTURA SCILLÆ. U. S. Tincture of Squill
[Tr. Scill.]

If assayed biologically the minimum lethal dose should not be greater than 0.006 mil of Tincture, or the equivalent in Tincture of 0.0000005 Gm. of ouabain, for each gramme of body weight of frog.

	Metric	Old form
***Squill,** in No. 20 powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the drug with sufficient menstruum, prepared by mixing 3 volumes of alcohol and 1 volume of water, and macerate it in a closed vessel in a moderately warm place for twenty-four hours, stirring occasionally. Then transfer it to a percolator, shake it down evenly without packing and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely

covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the same menstruum to make 1000 mils [old form 2 pints] of Tincture.

Assay.—For a method of assaying Tincture of Squill, see Biological Assays (Chapter LXII).

Average dose.—15 minims (1 mil).

TINCTURA STRAMONII. U. S. Tincture of Stramonium [Tr. Stramon.]

One hundred mils of Tincture of Stramonium yields not less than 0.0225 Gm. nor more than 0.0275 Gm. of the total alkaloids of stramonium.

	Metric	Old form
***Stramonium**, in No. 60 powder	**100 Gm.**	3 oz. av. 148 gr.
Diluted Alcohol, a sufficient quantity,		
To make about	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of diluted alcohol to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding menstruum until the percolate measures 950 mils [old form about 30½ fl. oz.]. Assay a sample of this percolate as directed and from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloids in the remainder of the liquid and adjust the volume of the finished Tincture so that each 100 mils contains 0.025 Gm. of the total alkaloids of stramonium. (U. S. P. Type Process P.)

Assay.—Evaporate 100 mils of Tincture of Stramonium on a water bath until it measures about 10 mils, transfer the evaporated liquid to a separator, and proceed as directed in the assay under *Fluidextractum Belladonnæ Radicis*, second line of the Assay, beginning with the words "add 10 mils," and modifying the process there given by using the ammonia water and about 5 mils of distilled water in addition to rinse the dish in which the Tincture was evaporated; before titrating treat the residue twice with 5 mils of ether, evaporating to dryness each time.

Average dose.—8 minims (0.5 mil).

TINCTURA STROPHANTHI. U. S. Tincture of Strophanthus [Tr. Strophanth. Strophanthi Tinctura P. I.]

If assayed biologically the minimum lethal dose should not be greater than 0.00006 mil of Tincture, or the equivalent in Tincture of 0.0000005 Gm. of ouabain, for each gramme of body weight of frog.

	Metric	Old form
***Strophanthus**, in No. 40 powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Pack the drug in a cylindrical percolator and slowly percolate it with

purified petroleum benzin until a few drops of the percolate, evaporated from filter paper, no longer leaves a greasy stain; then remove the strophanthus from the percolator and expose it to the air until it is dry and the odor of benzin has disappeared.

Moisten this dried drug with a sufficient quantity of alcohol to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the menstruum to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

The U. S. P. 1890 Tincture of Strophanthus was one-half the strength of the present tincture. This change was made in 1905 to bring this tincture into conformity with the standards of the Brussels Protocol. The preliminary extraction of the drug with benzin removes the fat from the strophanthus so that the resulting tincture will remain clear and will not be so likely to produce nausea.

Assay.—For a method of assaying Tincture of Strophanthus, see Biological Assays (Chapter LXII.)

Average dose.—8 minims (0.5 mil).

TINCTURA TOLUTANA. U. S. Tincture of Tolu
[Tr. Tolu. Tolu Tincture]

	Metric	Old form
***Balsam of Tolu**	200 Gm.	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Macerate the drug in a stoppered container, in a moderately warm place with 750 mils [old form 24 fl. oz.] of alcohol. Continue the maceration with frequent agitation during three days or until the drug is practically extracted, transfer the mixture to a filter, and, when the liquid has drained off completely, gradually wash the residue on the filter with enough of the solvent to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process M.)

U. S. P. Preparation.—Syrupus Tolutanus.

Average dose.—30 minims (2 mils).

TINCTURA VALERIANÆ. U. S. Tincture of Valerian
[Tr. Valer.]

	Metric	Old form
***Valerian**, in No. 40 powder	200 Gm.	6 oz. av. 296 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 mils	2 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 3 volumes of alcohol and 1 volume of water,

to render it evenly and distinctly damp, transfer it to a percolator, and without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the menstruum to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

Average dose.—1 fluidrachm (4 mils).

TINCTURA VALERIANÆ AMMONIATA. U. S. **Ammoniated Tincture of Valerian**

[Tr. Valer. Ammon.]

	Metric	Old form
***Valerian,** in No. 40 powder	**200 Gm.**	6 oz. av. 296 gr.
Aromatic Spirit of Ammonia, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of aromatic spirit of ammonia to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the menstruum to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

Average dose.—30 minims (2 mils).

TINCTURA VERATRI VIRIDIS. U. S. **Tincture of Veratrum Viride**

[Tr. Verat. Vir.]

	Metric	Old form
***Veratrum Viride,** in No. 60 powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of alcohol to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the menstruum to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

Average dose.—8 minims (0.5 mil).

TINCTURA ZINGIBERIS. U. S. Tincture of Ginger

[Tr. Zingib. TINCTURE OF JAMAICA GINGER]

	Metric	Old form
***Jamaica Ginger**, in No. 30 powder	200 Gm.	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	1000 mils	2 pints

Moisten the powdered drug with a sufficient quantity of alcohol to render it evenly and distinctly damp, transfer it to a percolator, and, without pressing the powder, allow it to stand well-covered for six hours; then pack it firmly, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the menstruum to make 1000 mils [old form 2 pints] of finished Tincture. (U. S. P. Type Process P.)

Impurities and Tests for Impurities.—Evaporate 10 Gm. of Tincture of Ginger to dryness in a tared dish on a water bath; the yield of residue does not exceed 2 per cent. When treated with 20 mils of cold distilled water, not more than 15 per cent. of this residue dissolves.

Capsicum or Similar Pungent Substitute.—Evaporate 10 mils of Tincture of Ginger to dryness in a small flask. Add 5 mils of half-normal alcoholic potassium hydroxide V.S. and boil the mixture gently for thirty minutes under a reflux condenser. Remove the condenser and evaporate the alcohol on a water bath. Then add 50 mils of distilled water to the residue, agitate the mixture, filter it and transfer the aqueous filtrate to a separatory funnel and shake it out with 25 mils of ether. Evaporate the separated ether solution spontaneously by adding it, a few drops at a time, to the center of a watch glass. Cautiously apply the tip of the tongue to the dry residue; the taste should be slightly camphoraceous but not sharp or bitingly pungent.

Alcohol Content.—About 90 per cent. of $C_2H_5.OH$ by volume.

In this tincture standards and tests have been introduced to prevent the use of weaker alcohol than that directed in the formula, which is sometimes done to cheapen the preparation. Also tests are added to exclude the addition of pungent substitutes, such as capsicum, added to the more aqueous tinctures to replace the ginger flavor, which will not be extracted by weak alcohol. "Exhausted ginger" is also sometimes used and the preparation "strengthened" by the addition of foreign pungent substances. The purpose of the tests is to prevent this.

U. S. P. Preparation.—Acidum Sulphuricum Aromaticum.

Average dose.—30 minims (2 mils).

The following general Formulas are recognized in the National Formulary:

TINCTURÆ ÆTHEREÆ. N. F. Ethereal Tinctures

Ethereal Tinctures, when not otherwise directed, are to be prepared according to the following general formula:

	Metric	Old form
The Drug, properly comminuted	100 Gm.	3 oz. 148 gr.
Alcohol,		
Ether, each, a sufficient quantity,		
To make	1000 mils	2 pints

Percolate the drug in the usual manner, but with proper precautions to avoid loss of menstruum by evaporation, with a mixture of 1 volume of ether and 2 volumes of alcohol, until the product measures 1000 mils [old form 2 pints].

TINCTURÆ MEDICAMENTORUM RECENTIUM. N. F. Tinctures of Fresh Drugs

[Tincturæ Herbarum Recentium, U. S. P. VIII]

Tinctures of fresh drugs, when not otherwise directed, are to be prepared according to the following general formula:

	Metric	Old form
The Fresh Drug, cut, bruised, or crushed	**500 Gm.**	16 oz. av. 302 gr.
Alcohol	**1000 mils**	2 pints

Macerate the drug with the alcohol in a closed vessel in a moderately warm place during fourteen days, with occasional stirring; then strongly express the liquid and filter it through paper.

TINCTURA ALOES ET MYRRHÆ. N. F. Tincture of Aloes and Myrrh

(U.S.P. VIII)

[Tr. Aloe. et Myrrh.]

	Metric	Old form
Aloes, in No. 40 powder	**100 Gm.**	3 oz. av. 148 gr.
Myrrh, in No. 40 powder	**100 Gm.**	3 oz. av. 148 gr.
Glycyrrhiza, in No. 40 powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix 750 mils [old form 24 fl. oz.] of alcohol with 250 mils [old form 8 fl. oz.] of water. Macerate the aloes, myrrh, and glycyrrhiza in a stoppered container, in a moderately warm place, with 750 mils [old form 24 fl. oz.] of the menstruum, for seven days, with occasional agitation; then filter through purified cotton, or a plain filter, and, when the liquid has drained off completely, pass enough menstruum through the residue to make the product measure 1000 mils [old form 2 pints].

N. F. Preparation.—Pilulæ Aloes, Hydrargyri et Scammonii Compositæ.

Average dose.—30 minims (2 mils).

TINCTURA AMARA. N. F. Bitter Tincture

[Tr. Amar. Stomachic Tincture Bitter Stomachic Drops Stomach Drops]

	Metric	Old form
Gentian, in No. 40 powder	**60 Gm.**	2 oz. av.
Centaury, in No. 40 powder	**60 Gm.**	2 oz. av.
Bitter Orange Peel, in No. 40 powder	**60 Gm.**	2 oz. av.
Zedoary, in No. 40 powder	**20 Gm.**	292 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Saturate the mixed drugs with the menstruum, and percolate them in the usual manner, with a mixture of 2 volumes of alcohol and 1 volume of water, until the tincture measures 1000 mils [old form 2 pints].

Average dose.—30 minims (2 mils).

TINCTURA ANTIPERIODICA. N. F. Antiperiodic Tincture

[Tr. Antiperiod. WARBURG'S TINCTURE]

	Metric	Old form
Rhubarb, in No. 30 powder	8.00 Gm.	117 gr.
Angelica Fruit, in No. 30 powder	8.00 Gm.	117 gr.
Inula, in No. 30 powder	4.00 Gm.	58 gr.
Saffron	4.00 Gm.	58 gr.
Fennel, in No. 30 powder	4.00 Gm.	58 gr.
Gentian, in No. 30 powder	2.00 Gm.	29 gr.
Zedoary, in No. 30 powder	2.00 Gm.	29 gr.
Cubeb, in No. 30 powder	2.00 Gm.	29 gr.
Myrrh, in coarse powder	2.00 Gm.	29 gr.
Camphor, in coarse powder	2.00 Gm.	29 gr.
Agaric, in No. 30 powder	2.00 Gm.	29 gr.
Pepper, in No. 30 powder	0.35 Gm.	5 gr.
Saigon Cinnamon, in No. 30 powder	0.75 Gm.	11 gr.
Ginger, in No. 30 powder	0.75 Gm.	11 gr.
Quinine Bisulphate	20.00 Gm.	292 gr.
Extract of Aloes	17.50 Gm.	255 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 mils	2 pints

Mix alcohol and water in the proportion of 3 volumes of alcohol and 2 volumes of water. Saturate the mixed drugs with the menstruum and having macerated them for twenty-four hours percolate them, in the usual manner, until the Tincture measures 960 mils [old form 30 fl. oz. 346 minims]. In this dissolve the quinine bisulphate and extract of aloes by the aid of a gentle heat, and add sufficient menstruum to make the product measure 1000 mils [old form 2 pints]. Finally filter the Tincture through paper.

Dose.—The dosage of Warburg's Tincture depends on the kind used —whether with aloes or without—and the intended purpose, and varies from 1 fluidrachm (4 mils) to 4 fluidrachms (15 mils). The larger quantity is given when Dr. Warburg's original directions are followed for administering the remedy in remittent fevers. These directions were as follows: "One-half ounce to be given alone, without dilution, after the bowels have been evacuated by any convenient purgative, all liquids being withheld. After three hours, another half ounce is to be given."

TINCTURA ANTIPERIODICA SINE ALOE. N. F. Antiperiodic Tincture without Aloes

[Tr. Antiperiod. s. Aloe WARBURG'S TINCTURE WITHOUT ALOES]

Prepare the Tincture as directed under *Tinctura Antiperiodica*, omitting the Extract of Aloes.

Dose.—See *Tinctura Antiperiodica.*

TINCTURA AROMATICA. N. F. Aromatic Tincture

[Tr. Arom.]

	Metric	Old form
Saigon Cinnamon, in No. 40 powder	100 Gm.	3 oz. av. 148 gr.
Jamaica Ginger, in No. 40 powder	40 Gm.	1 oz. av. 147 gr.
Galangal, in No. 40 powder	20 Gm.	292 gr.
Clove, in No. 20 powder	20 Gm.	292 gr.
Cardamom Seed, in No. 20 powder	20 Gm.	292 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 mils	2 pints

Saturate the mixed drugs with the menstruum, and having macerated them for twenty-four hours percolate them, in the usual manner, with a mixture of 2 volumes of alcohol and 1 volume of water, until the product measures 1000 mils [old form 2 pints].

Average dose.—30 minims (2 mils).

TINCTURA BRYONIÆ. N. F. Tincture of Bryonia
[Tr. Bryon.]

	Metric	Old form
Bryonia, in No. 40 powder	**100 Gm.**	**3 oz. av. 148 gr.**
Alcohol, a sufficient quantity,		
To make	**1000 mils**	**2 pints**

Saturate the powder with alcohol and macerate it for twenty-four hours. Then percolate it, in the usual manner, with alcohol until the product measures 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

TINCTURA CACTI GRANDIFLORI. N. F. Tincture of Cactus Grandiflorus
[Tr. Cact. Grand.]

	Metric	Old form
Cactus Grandiflorus	**500 Gm.**	**16 oz. av. 302 gr.**
Alcohol, a sufficient quantity,		
To make	**1000 mils**	**2 pints**

Cut the cactus grandiflorus and crush it in a mortar, then add 700 mils [old form about 22½ fl. oz.] of alcohol and transfer the mixture to a closed vessel and macerate for seven days with occasional agitation. Express the drug, measure the expressed liquid and set it aside in a closed container. Pack the residue firmly in a percolator and slowly percolate it with alcohol until a sufficient quantity of percolate is obtained and added to the reserved expressed liquid, to make the product measure 1000 mils [old form 2 pints]. Filter the Tincture and store it in well-stoppered bottles, in a cool place.

In this tincture the fresh succulent stems of cactus grandiflorus must be used. These are preserved in alcohol until the tincture is to be made.

Average dose.—15 minims (1 mil).

TINCTURA CALENDULÆ. N. F. Tincture of Calendula
(U.S.P. VIII)
[Tr. Calend.]

	Metric	Old form
Calendula, in No. 20 powder	**200 Gm.**	**6 oz. av. 296 gr.**
Alcohol, a sufficient quantity,		
To make	**1000 mils**	**2 pints**

Saturate the powder with alcohol, and after macerating for twenty-four hours percolate it, in the usual manner, with alcohol until the product measures 1000 mils [old form 2 pints].

TINCTURA CAPSICI ET MYRRHÆ. N. F. Tincture of Capsicum and Myrrh

[Tr. Capsic. et Myrrh. HOT DROPS THOMSONIAN NUMBER SIX]

	Metric	Old form
Capsicum, in No. 20 powder	**30 Gm.**	1 oz. av.
Myrrh, in moderately coarse powder	**120 Gm.**	4 oz. av. 3 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the powders with an equal bulk of clean, fine sand, and percolate them, in the usual manner, with a mixture of 9 volumes of alcohol and 1 volume of water, until the product measures 1000 mils [old form 2 pints].

Average dose.—30 minims (2 mils).

TINCTURA CARAMELLIS. N. F. Tincture of Caramel

	Metric	Old form
Caramel	**100 Gm.**	3 oz. av. 148 gr.
Alcohol	**250 mils**	8 fl. oz.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the caramel in 500 mils [old form 1 pint] of water, with the aid of heat if necessary, then add the alcohol and sufficient water to make the product measure 1000 mils [old form 2 pints]. Finally filter the Tincture.

N. F. Preparations.—Elixir Pepsini et Bismuthi; Elixir Vanillini Compositum.

TINCTURA CIMICIFUGÆ. N. F. Tincture of Cimicifuga

(U.S.P. VIII)

[Tr. Cimicif.]

	Metric	Old form
Cimicifuga, in No. 40 powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Saturate the powder with alcohol, and, after macerating for twenty-four hours, percolate it, in the usual manner, with alcohol until the product measures 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

TINCTURA COCCULI INDICI. N. F. Tincture of Cocculus Indicus

[Tr. Coccul. Ind.]

	Metric	Old form
Cocculus Indicus, in No. 30 powder	**100 Gm.**	3 oz. av. 148 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Saturate the powder with diluted alcohol, and after macerating for six hours percolate it, in the usual manner, with diluted alcohol until the product measures 1000 mils [old form 2 pints].

NOTE.—This Tincture is used almost exclusively for external application to destroy parasites.

TINCTURA CROCI. N. F. Tincture of Saffron
[Tr. Croc.]

	Metric	Old form
Saffron	**100 Gm.**	3 oz. av. 148 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Saturate the saffron with diluted alcohol, and after macerating for twenty-four hours percolate it, in the usual manner, with diluted alcohol until the product measures 1000 mils [old form 2 pints].

TINCTURA CUBEBÆ. N. F. Tincture of Cubeb
[Tr. Cubeb.]

	Metric	Old form
Cubeb, in No. 30 powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Saturate the powder with alcohol, and after macerating for twenty-four hours percolate it, in the usual manner, with alcohol until the product measures 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

TINCTURA DELPHINII. N. F. Tincture of Larkspur
[Tr. Delphin.]

	Metric	Old form
Larkspur Seed, in No. 30 powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Saturate the powder with alcohol, and after macerating for six hours percolate it, in the usual manner, with alcohol until the product measures 1000 mils [old form 2 pints].

NOTE.—Tincture of Larkspur is rarely used internally, but is commonly employed externally to destroy parasites.

TINCTURA ERGOTÆ AMMONIATA. N. F. Ammoniated Tincture of Ergot
[Tr. Ergot. Ammon.]

	Metric	Old form
Ergot, in No. 20 powder	**250 Gm.**	8 oz. av. 151 gr.
Ammonia Water	**100 mils**	3 fl. oz. 96 min.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the ammonia water with 600 mils [old form 19 fl. oz. 96 minims] of alcohol and 200 mils [old form 6 fl. oz. 192 minims] of water. Sat-

urate the powder with this menstruum, and, after macerating for twenty-four hours, percolate it, in the usual manner, first with the remainder of the above menstruum and afterward with a mixture of 2 volumes of alcohol and 1 volume of water, until the product measures 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

TINCTURA FERRI CHLORIDI ÆTHEREA. N. F. **Ethereal Tincture of Ferric Chloride**

[Tr. Ferr. Chlor. Æth. BESTUSCHEFF'S TINCTURE. LAMOTTE'S DROPS]

	Metric	Old form
Solution of Ferric Chloride	**60 mils**	1 fl. oz. 442 min.
Ether	**250 mils**	8 fl. oz.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the solution of ferric chloride with 625 mils [old form 20 fl. oz.] of alcohol, add the ether, and then enough alcohol to make the product measure 1000 mils [old form 2 pints]. Pour the Tincture into bottles made of flint glass, which should not be entirely filled, cork them tightly and expose them to the rays of the sun, until the Tincture has been completely decolorized. Then remove the bottles from the sunlight and open them occasionally, until the liquid has again assumed a yellow color. Preserve the Tincture in a cool and dark place.

Average dose.—30 minims (2 mils).

TINCTURA FERRI CITRO-CHLORIDI. N. F. **Tincture of Ferric Citro-Chloride**

[Tr. Ferr. Citro-Chlor. TASTELESS TINCTURE OF FERRIC CHLORIDE TASTELESS TINCTURE OF IRON]

	Metric	Old form
Solution of Ferric Chloride	**350 mils**	11 fl. oz. 96 min.
Sodium Citrate	**500 Gm.**	16 oz. av. 302 gr.
Alcohol	**150 mils**	4 fl. oz. 384 min.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the solution of ferric chloride with 150 mils [old form 4 fl. oz. 384 minims] of water, and dissolve the sodium citrate in this mixture with the aid of a gentle heat. Then add the alcohol, and when the solution has become cold add sufficient water to make the product measure 1000 mils [old form 2 pints]. Set the Tincture aside in a cold place for a few days, so that the excess of saline matter may separate, and then filter.

N. F. Preparations.—Elixir Ferri, Quininæ et Strychninæ; Elixir Gentianæ et Ferri; Elixir Pepsini et Ferri; Liquor Ferri Salicylatis; Vinum Pruni Virgininæ Ferratum.

Average dose.—8 minims (0.5 mil).

TINCTURA FERRI POMATA. N. F. **Tincture of Ferrated Extract of Apples**

[Tr. Ferr. Pomat. TINCTURA FERRI MALATIS CRUDI TINCTURE OF CRUDE MALATE OF IRON]

	Metric	Old form
Ferrated Extract of Apples	**100 Gm.**	3 oz. av. 148 gr.
Alcohol	**100 mils**	3 fl. oz. 96 min.
Cinnamon Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the ferrated extract of apples in 750 mils [old form 24 fl. oz.] of cinnamon water, add the alcohol, filter, and pass sufficient cinnamon water through the filter to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

TINCTURA GALLÆ. N. F. **Tincture of Nutgall**

(Replacing U.S.P. VIII)

[Tr. Gall.]

	Metric	Old form
Nutgall, in No. 60 powder	**200 Gm.**	6 oz. av. 296 gr.
Glycerin	**100 mils**	3 fl. oz. 96 min.
Alcohol	**900 mils**	28 fl. oz. 384 min.

Triturate the nutgall with the mixed glycerin and alcohol, transfer the mixture to a suitable container, and macerate it in a moderately warm place for seven days with frequent agitation. Finally filter.

Average dose.—1 fluidrachm (4 mils).

TINCTURA GUAIACI COMPOSITA. N. F. **Compound Tincture of Guaiac**

[Tr. Guaiac. Co. DEWEES' TINCTURE OF GUAIAC]

	Metric	Old form
Guaiac	**125 Gm.**	4 oz. av. 76 gr.
Potassium Carbonate	**6 Gm.**	88 gr.
Pimenta, in moderately fine powder	**32 Gm.**	1 oz. av. 30 gr.
Pumice, in fine powder	**65 Gm.**	2 oz. av. 74 gr.
Alcohol	**435 mils**	13 fl. oz. 442 min.
Water	**435 mils**	13 fl oz. 442 min.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Triturate the guaiac and potassium carbonate with the pimenta and the pumice, and afterwards with the alcohol, gradually added. Then add the water slowly and triturate the mixture thoroughly. Finally filter and pass sufficient diluted alcohol through the filter to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

TINCTURA HUMULI. N. F. **Tincture of Hops**

[Tr. Humul.]

	Metric	Old form
Hops, in No. 40 powder	**200 Gm.**	6 oz. av. 296 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Saturate the powder with diluted alcohol, and after macerating for twenty-four hours percolate it, in the usual manner, with diluted alcohol until the product measures 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

TINCTURA IGNATIÆ. N. F. Tincture of Ignatia [Tr. Ignat.]

100 mils of Tincture of Ignatia yields not less than 0.18 Gm. nor more than 0.22 Gm. of the alkaloids of ignatia.

	Metric	Old form
Ignatia, in No. 60 powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	2 pints

Mix alcohol and water in the proportion of 8 volumes of alcohol to 1 volume of water. Moisten the powder with 100 mils [old form 3 fl. oz. 96 minims] of this menstruum, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it, until the ignatia is practically exhausted. Reserve the first 800 mils [old form about 25½ fl. oz.] of percolate, evaporate the remainder to 100 mils [old form about 3¼ fl. oz.] and mix with the reserved portion. Assay 100 mils of this liquid for total alkaloids as directed below, and from the results thus obtained ascertain by calculation the amount of alkaloids in the remainder of the liquid, and add to this sufficient menstruum so that each 100 mils of finished Tincture shall contain 0.2 Gm. of the alkaloids of ignatia.

Assay.—Evaporate 100 mils of Tincture of Ignatia on a water bath until it measures about 10 mils, transfer the evaporated liquid to a separator, and proceed as directed in the Assay under *Fluidextractum Stramonii*, modifying the process there given by using 5 mils of ammonia water with a little distilled water, in divided portions, to rinse the dish in which the Tincture was evaporated and by dissolving the residue in 10 mils of tenth-normal sulphuric acid V.S. instead of 5 mils.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 36.4 milligrammes of the alkaloids of ignatia.

Average dose.—10 minims (0.6 mil).

TINCTURA IODI FORTIOR. N. F. Stronger Tincture of Iodine [Tr. Iod. Fort. Churchill's Tincture of Iodine]

	Metric	Old form
Iodine	**165 Gm.**	5 oz. av. 222 gr.
Potassium Iodide	**33 Gm.**	1 oz. av. 44 gr.
Water	**250 mils**	8 fl. oz.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the potassium iodide in the water, then add the iodine and 600 mils [old form about 19¼ fl. oz.] of alcohol, and when all of the iodine is dissolved add sufficient alcohol to make the product measure 1000 mils [old form 2 pints].

TINCTURA IODI DECOLORATA. N. F. Decolorized Tincture of Iodine

[Tr. Iod. Decolor.]

	Metric	Old form
Iodine	**83 Gm.**	2 oz. av. 337 gr.
Sodium Thiosulphate	**83 Gm.**	2 oz. av. 337 gr
Water	**100 mils**	3 fl. oz. 96 min.
Stronger Ammonia Water	**65 mils**	2 fl. oz. 38 min.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Digest the iodine, sodium thiosulphate and water, at a gentle heat, until complete solution results. Then add 125 mils [old form 4 fl. oz.] of alcohol and afterwards the stronger ammonia water. Shake the mixture a few minutes until bubbles of gas no longer escape, and the liquid has become colorless with a white precipitate suspended in it. Now cool the mixture, and then add sufficient alcohol to make the product measure 1000 mils [old form 2 pints]. Place the bottle containing the liquid in a cold place for a few hours and then filter. Preserve the Tincture in a well-stoppered bottle.

TINCTURA IPECACUANHÆ ET OPII. N. F. Tincture of Ipecac and Opium

(U.S.P. VIII)

[Tr. Ipecac. et Opii TINCTURE OF DOVER'S POWDER]

	Metric	Old form
Tincture of Deodorized Opium	**1000 mils**	2 pints
Fluidextract of Ipecac	**100 mils**	3 fl. oz. 96 min.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Evaporate the tincture of deodorized opium in a tared dish on a water bath until it weighs 700 Gm. [old form 23 oz. av. 160 grains]. When it has become cold, add to it the fluidextract of ipecac, filter the mixture and wash the filter with sufficient diluted alcohol to make the product measure 1000 mils [old form 2 pints].

N. F. Preparation.—Syrupus Ipecacuanhæ et Opii.

Average dose.—8 minims (0.5 mil).

TINCTURA JALAPÆ. N. F. Tincture of Jalap

[Tr. Jalap.]

	Metric	Old form
Jalap, in No. 60 powder	**200 Gm.**	6 oz. av. 293 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix 2 volumes of alcohol with 1 volume of water and percolate the jalap with this menstruum, in the usual manner, until the product measures 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

TINCTURA JALAPÆ COMPOSITA. N. F. **Compound Tincture of Jalap**

[Tr. Jalap. Co.]

	Metric	Old form
Jalap, in No. 60 powder	**125 Gm.**	4 oz. av. 76 gr.
Resin of Scammony, in No. 60 powder	**30 Gm.**	1 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix 2 volumes of alcohol with 1 volume of water. Triturate the powders with half their weight of clean sand; moisten the mixture with a sufficient quantity of the menstruum, pack it in a percolator, and percolate it with the menstruum, in the usual manner, until the product measures 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

TINCTURA KINO ET OPII COMPOSITA. N. F. **Compound Tincture of Kino and Opium**

[Tr. Kino et Opii Co. TINCTURA KINO COMPOSITA, N. F. III COMPOUND TINCTURE OF KINO]

	Metric	Old form
Tincture of Kino	**200.0 mils**	6 fl. oz. 192 min.
Tincture of Opium	**100.0 mils**	3 fl. oz. 96 min.
Spirit of Camphor	**65.0 mils**	2 fl. oz. 38 min.
Oil of Clove	**1.5 mils**	23 min.
Cochineal, in fine powder	**8.5 Gm.**	124 gr.
Aromatic Spirit of Ammonia	**8.0 mils**	123 min.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Triturate the cochineal with the aromatic spirit of ammonia, and gradually add 625 mils [old form 20 fl. oz.] of diluted alcohol. Then add the two tinctures, the spirit of camphor, and the oil of clove, and sufficient diluted alcohol to make the product measure 1000 mils [old form 2 pints]. Finally filter.

Average dose.—1 fluidrachm (4 mils).

TINCTURA KRAMERIÆ. N. F. **Tincture of Krameria**

(U.S.P. VIII)

[Tr. Kramer.]

	Metric	Old form
Krameria, in No. 40 powder	**200 Gm.**	6 oz. av. 296 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Saturate the powder with diluted alcohol, and, after macerating for twenty-four hours, percolate it, in the usual manner, with diluted alcohol until the product measures 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

TINCTURA OPII CROCATA. N. F. **Tincture of Opium with Saffron**
[Tr. Opii Crocat. SYDENHAM'S LAUDANUM **TINCTURA OPII CROCATA P. I.]**

One hundred mils of Tincture of Opium with Saffron yields not less than 0.95 Gm. nor more than 1.05 Gm. of anhydrous morphine.

	Metric	Old form
Granulated Opium	**100 Gm.**	3 oz. av. 148 gr.
Saffron, in No. 20 powder	**25 Gm.**	365 gr.
Saigon Cinnamon, in No. 60 powder	**6 Gm.**	88 gr.
Clove, in No. 30 powder	**6 Gm.**	88 gr.
Diluted Alcohol, a sufficient quantity,		
To make about	**1000 mils**	2 pints

Triturate the drugs in a mortar with an equal bulk of clean sand, then rub them to a smooth paste with a portion of the diluted alcohol and after macerating for two days percolate it, in the usual manner, with diluted alcohol until the product measures 900 mils [old form 28 fl. oz. 384 minims]. Assay 80 mils of this liquid as directed below and, from the result thus obtained, ascertain by calculation the amount of anhydrous morphine in the remainder of the liquid and add to this enough diluted alcohol to make each 100 mils of finished Tincture contain 1 Gm. of anhydrous morphine.

Assay.—Evaporate 80 mils of Tincture of Opium with Saffron on a water bath until the alcohol is all removed. Transfer the extract to a 50-mil graduated flask and wash the evaporating dish with sufficient distilled water to make the entire volume exactly 50 mils when cooled to room temperature. Place in a small mortar 4 Gm. of freshly slaked lime (see Reagents, Chapter LXII), add about 10 mils of the opium solution and rub to a smooth paste, then add the remainder of the solution and rinse the flask with exactly 10 mils of distilled water, adding the rinsings to the mortar, and stir frequently during fifteen minutes. Filter through a dry filter, about 10 cm. in diameter, and transfer exactly 30 mils of the filtrate, representing 40 mils of the Tincture, to an Erlenmeyer flask of suitable capacity. To this add 2 mils of alcohol and 15 mils of ether, and, after shaking the mixture, add 1 Gm. of ammonium chloride, stopper the flask and shake it frequently during half an hour, then set it aside in a cool place for twelve hours or over night. Remove the stopper and brush any adhering crystals back into the flask. Decant the ethereal layer into a small funnel, the neck of which has been previously closed with a pledget of purified cotton. Rinse the flask and contents with 15 mils of ether, and, when the ether has passed through, wash the funnel and cotton with a small quantity of ether, and then pour the aqueous liquid into the funnel without trying to remove the crystals. Wash the crystals in the flask and the contents of the funnel with distilled water, previously saturated with morphine, until the washings are colorless. Then add a few drops of distilled water to replace the morphinated water. Incline the edge of the funnel over the mouth of the flask and by means of a glass rod carefully transfer the cotton with adhering crystals to the flask. Insert the funnel into the neck of the flask and wash the funnel with 20 mils of tenth-normal sulphuric acid V.S., followed by 10 mils of distilled water, applied drop by drop around the edge of the funnel. Remove the funnel, replace the cork, warm gently, and agitate until the crystals are dissolved. Rinse the cork with distilled water and titrate the excess of acid with fiftieth-normal potassium hydroxide V.S., cochineal T.S. or methyl orange T.S. being used as indicator. Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 0.0285 Gm. of anhydrous morphine.

Average dose.—10 minims (0.6 mil).

TINCTURA PARACOTO. N. F. **Tincture of Paracoto**
[Tr. Paracoto TINCTURA COTO, N.F. III]

	Metric	Old form
Paracoto, in No. 40 powder	**125 Gm.**	4 oz. 76 gr.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

· Saturate the powder, in a percolator, with alcohol, and after macerating for twenty-four hours percolate it, in the usual manner, with alcohol until the product measures 1000 mils [old form 2 pints].

Average dose.—30 minims (2 mils).

TINCTURA PASSIFLORÆ. N. F. Tincture of Passion Flower
[Tr. Passiflor.]

	Metric	Old form
Passion Flower, in No. 20 powder	**200 Gm.**	6 oz. av. 296 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Saturate the passion flower with diluted alcohol, and after macerating for twenty-four hours percolate, in the usual manner, with diluted alcohol until the product measures 1000 mils [old form 2 pints].

Average dose.—10 minims (0.6 mil).

TINCTURA PECTORALIS. N. F. Pectoral Tincture
[Tr. Pectoral. Guttæ Pectorales Pectoral Drops Bateman's Pectoral Drops]

	Metric	Old form
Tincture of Opium	**42 mils**	1 fl. oz. 165 min.
Compound Tincture of Gambir	**64 mils**	2 fl. oz. 23 min.
Spirit of Camphor	**40 mils**	1 fl. oz. 134 min.
Oil of Anise	**1 mil**	15 min.
Caramel	**16 Gm.**	234 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the several ingredients with sufficient diluted alcohol to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—Infants, 10 minims (0.6 mil).

TINCTURA PERSIONIS. N. F. Tincture of Cudbear
[Tr. Persion.]

	Metric	Old form
Cudbear, in fine powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Place the cudbear in a suitable percolator, and percolate it with a mixture of 3 volumes of alcohol and 1 volume of water until the product measures 1000 mils [old form 2 pints].

This red tincture is used for coloring other preparations, but because of the difficulty in completely extracting it, the color value of different lots of tincture shows much variation. To maintain a uniform color in preparations where this tincture is used as a coloring agent it is best to adopt a particular shade, keep this as the standard color and then when each new preparation is made add more or less of the tincture, as required to make the new preparation conform to the standard.

N. F. Preparation.—Syrupus Phosphatum Compositus.

TINCTURA PERSIONIS COMPOSITA. N. F. **Compound Tincture of Cudbear**
[Tr. Persion. Co.]

	Metric	Old form
Cudbear, in fine powder	**15 Gm.**	219 gr
Caramel	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix 1 volume of alcohol with 2 volumes of water and macerate the cudbear with 750 mils [old form 24 fl. oz.] of this solvent, during twelve hours, agitating occasionally. Then filter, add the caramel, previously dissolved in 125 mils [old form 4 fl. oz.] of the solvent, and finally pass enough of the solvent through the filter to make the product measure 1000 mils [old form 2 pints].

This tincture is used to produce a reddish-brown color in pharmaceutical preparations.

N. F. Preparations.—Elixir Ammonii Valeratis; Elixir Cinchonæ Alkaloidorum; Elixir Quininæ Valeratis et Strychninæ; Elixir Strychninæ Valeratis; Elixir Zinci Valeratis; Syrupus Bromidorum.

TINCTURA PIMPINELLÆ. N. F. **Tincture of Pimpinella**
[Tr. Pimpinel.]

	Metric	Old form
Pimpinella, in No. 40 powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix 2 volumes of alcohol with 1 volume of water. Saturate the powder with the menstruum and, after macerating for twelve hours, percolate it, in the usual manner, using menstruum of the same strength until the product measures 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

TINCTURA PULSATILLÆ. N. F. **Tincture of Pulsatilla**
[Tr. Pulsatil.]

	Metric	Old form
Pulsatilla, in No. 30 powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix 3 volumes of alcohol with 1 volume of water. Saturate the powder with the menstruum and, after macerating for six hours, percolate it, in the usual manner, using menstruum of the same strength, until the product measures 1000 mils [old form 2 pints].

Average dose.—30 minims (2 mils).

TINCTURA QUILLAJÆ. N. F. **Tincture of Quillaja**
(U. S. P. VIII)
[Tr. Quillaj.]

	Metric	Old form
Quillaja, in No. 20 powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol	**350 mils**	11 fl. oz. 96 min.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Boil the quillaja in a covered vessel with 800 mils [old form about 25½ fl. oz.] of water for fifteen minutes, strain while hot, and wash the residue on the strainer with 200 mils [old form about 6¼ fl. oz.] of boiling water. Then evaporate the strained liquid to 600 mils [old form about 19 fl. oz.], allow it to cool, add the alcohol, and set it aside for twelve hours. Decant the supernatant liquid, filter it, then pour the residue on the filter, and, when the liquid ceases to drop, wash the filter with sufficient water to make the product measure 1000 mils [old form 2 pints].

TINCTURA RHEI AQUOSA. N. F. **Aqueous Tincture of Rhubarb**
[Tr. Rhei Aq.]

	Metric	Old form
Rhubarb	**100 Gm.**	3 oz. av. 148 gr.
Potassium Carbonate	**10 Gm.**	146 gr.
Cinnamon Water	**125 mils**	4 fl. oz.
Alcohol	**110 mils**	3 fl. oz. 250 min.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the potassium carbonate in 750 mils [old form 24 fl. oz.] of water, and macerate the rhubarb in this solution during twenty-four hours, having first cut it into thin slices and carefully freed it from any adhering fine powder. Strain this mixture through muslin, heat the strained liquid to boiling, add the cinnamon water and alcohol, stir it well and, while warm, filter it in a covered funnel. To the cold filtrate add sufficient water to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

TINCTURA RHEI DULCIS. N. F. **Sweet Tincture of Rhubarb**
[Tr. Rhei Dulc.]

	Metric	Old form
Rhubarb, in No. 40 powder	**100 Gm.**	3 oz. av. 148 gr.
Glycyrrhiza, in No. 40 powder	**40 Gm.**	1 oz. av. 147 gr.
Anise, in No. 20 powder	**40 Gm.**	1 oz. av. 147 gr.
Cardamom Seed, in No. 20 powder	**10 Gm.**	146 gr.
Glycerin	**100 mils**	3 fl. oz. 96 min.
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the glycerin with 500 mils [old form 1 pint] of alcohol and 400 mils [old form 12 fl. oz. 384 minims] of water. Saturate the mixed powders with sufficient of this menstruum, and macerate them for twenty-

four hours; then percolate them in the usual manner, first with the above glycerinated menstruum and afterwards with sufficient diluted alcohol to make the product measure 1000 mils [old form 2 pints].

Average dose.—30 minims (2 mils).

TINCTURA RHEI ET GENTIANÆ. N. F. **Tincture of Rhubarb and Gentian**

[Tr. Rhei et Gent.]

	Metric	Old form
Rhubarb, in No. 40 powder	**70.0 Gm.**	2 oz. av. 147 gr.
Gentian, in No. 40 powder	**17.5 Gm.**	255 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	2 pints

Saturate the mixed powders with sufficient diluted alcohol and macerate for six hours; then percolate in the usual manner with diluted alcohol until the product measures 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

TINCTURA SABAL ET SANTALI. N. F. **Tincture of Saw Palmetto and Santal**

[Tr. Sabal et Santal.]

	Metric	Old form
Sabal, in about No. 16 powder	**200 Gm.**	6 oz. av. 296 gr.
Sandal Wood, in No. 60 powder	**65 Gm.**	2 oz. av. 74 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix 4 volumes of alcohol with 1 volume of water, and saturate the drugs with this menstruum. After macerating for two days, percolate them in the usual manner with sufficient menstruum of the same strength until the product measures 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

TINCTURA SERPENTARIÆ. N. F. **Tincture of Serpentaria**

(U. S. P. VIII)

[Tr. Serpent.]

	Metric	Old form
Serpentaria, in No. 50 powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix 2 volumes of alcohol with 1 volume of water. Saturate the powder with this menstruum, and after macerating for twenty-four hours percolate it in the usual manner with sufficient menstruum of the same strength until the product measures 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

TINCTURA SUMBUL. N. F. Tincture of Sumbul
[Tr. Sumbul]

	Metric	Old form
Sumbul, in No. 30 powder	100 Gm.	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 mils	2 pints

Mix 2 volumes of alcohol with 1 volume of water. Saturate the powder with this menstruum, and, after macerating for twenty-four hours, percolate it in the usual manner with sufficient menstruum of the same strength until the product measures 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

TINCTURA VANILLÆ. N. F. Tincture of Vanilla
(U. S. P. VIII)
[Tr. Vanill.]

	Metric	Old form
Vanilla, cut into small pieces	100 Gm.	3 oz. av. 148 gr.
Sugar, in coarse granules	200 Gm.	6 oz. av. 296 gr.
Alcohol,		
Diluted Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 mils	2 pints

Macerate the vanilla with 500 mils [old form 1 pint] of alcohol in a stoppered container, in a moderately warm place, for two days, with frequent agitation; then transfer it to a plain filter and reserve the filtered liquid. Spread out the drug on the filter and expose it to the air until all of the alcohol has evaporated. Then grind the vanilla and sugar to a uniform powder, pack this in a percolator and slowly percolate it with a mixture of the reserved filtrate and an equal volume of water. When the liquid ceases to drop, continue the percolation slowly, gradually adding the remainder of the prepared menstruum and then sufficient diluted alcohol to make the product measure 1000 mils [old form 2 pints].

N. F. Preparations.—Elixir Ammonii Valeratis; Elixir Humuli; Elixir Strychninæ Valeratis; Emulsum Olei Ricini; Syrupus Bromidorum.

TINCTURA VIBURNI OPULI COMPOSITA. N. F. Compound Tincture of Viburnum
[Tr. Viburn. Opul. Co.]

	Metric	Old form
Viburnum Opulus, in No. 40 powder	35 Gm.	1 oz. av. 74 gr.
Dioscorea, in No. 40 powder	35 Gm.	1 oz. av. 74 gr.
Scutellaria, in No. 40 powder	10 Gm.	146 gr.
Clove, in No. 20 powder	50 Gm.	1 oz. av. 293 gr.
Saigon Cinnamon, in No. 40 powder	65 Gm.	2 oz. av. 74 gr.
Glycerin	75 mils	2 fl. oz. 192 min.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 mils	2 pints

Mix the glycerin with 750 mils [old form 24 fl. oz.] of alcohol and 175 mils [old form 5 fl. oz. 288 minims] of water. Saturate the powders with this menstruum and, after macerating for forty-eight hours, percolate them in the usual manner, first with the above menstruum, then with a mixture of 3 volumes of alcohol and 1 volume of water, until the product measures 1000 mils [old form 2 pints].

Average dose—1 fluidrachm (4 mils).

TINCTURA ZEDOARIÆ AMARA. N. F. **Bitter Tincture of Zedoary**
[Tr. Zedoar. Amar. COMPOUND TINCTURE OF ZEDOARY]

	Metric	Old form
Zedoary, in No. 40 powder	**250 Gm.**	8 oz. av. 151 gr.
Aloes, in fine powder	**125 Gm.**	4 oz. av. 76 gr.
Rhubarb, in No. 40 powder	**62 Gm.**	2 oz. av. 30 gr.
Gentian, in No. 40 powder	**62 Gm.**	2 oz. av. 30 gr.
Agaric, in No. 40 powder	**62 Gm.**	2 oz. av. 30 gr.
Saffron, in No. 40 powder	**62 Gm.**	2 oz. av. 30 gr.
Glycerin	**125 mils**	4 fl. oz.
Alcohol, **Water,** each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix 2 volumes of alcohol with 1 volume of water. Saturate the mixed drugs with the above menstruum, and percolate in the usual manner, with this menstruum, until the product measures 750 mils [old form 24 fl. oz.]. Add to this the glycerin and set it aside. Then continue the percolation until the drugs are practically exhausted, evaporate the last percolate to about 120 mils [old form about 4 fl. oz.], mix it with the reserved portion, and then add sufficient menstruum to make the product measure 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

Vina Medicata *Medicated Wines*

These are liquid preparations containing the soluble principles of medicinal substances dissolved in wine. Pharmaceutically they most resemble tinctures, differing from them merely in the character of the menstruum. The fermented juice of the grape, known as "Sherry Wine," containing not less than 16 per cent. nor more than 24 per cent., by volume, of alcohol, is the menstruum used as the basis for medicated wines which are now recognized only by the National Formulary. The Committee of Revision of the U. S. P. IX decided that in conformity with the recommendation of the Brussels Protocol that "no potent drug shall be prepared in the form of a medicinal wine," and because of the variability of commercial grades of wine, it would be best to omit this class of preparations. They have the advantage over infusions and decoctions of being much more permanent preparations, on account of the presence of alcohol.

There are *sixteen* wines recognized by the N. F. IV; *one* is not medicated; *eleven* are made by solution or admixture; and *four* by maceration or percolation.

Wines of the N. F. IV

Title	Ingredients	Method of Preparation
Not Medicated		
Vinum Xericum (Sherry Wine)	An alcoholic liquid containing from 16 to 24 per cent. of Alcohol, by volume	Made by fermenting the juice of fresh ripe grapes, freed from seeds, stems, and skins, and fortifying with pure grape brandy
Made by Solution or Admixture		
Vinum Antimonii	4 Gm. Antimony and Potassium Tartrate; 25 mils Boiling Distilled Water; Sherry Wine, enough to make 1000 mils	Dissolve the salt in the Boiling Water, add 725 mils of Sherry Wine and, when cold, add enough Wine to make 1000 mils and filter
Carnis	30 Gm. Extract of Beef; 60 mils Hot Water; 100 mils Syrup; 50 mils Alcohol; 1 mil Compound Spirit of Orange; Sherry Wine, enough to make 1000 mils	Dissolve the Extract of Beef in the Hot Water, add the Syrup, the Spirit and Alcohol, mixed, and enough Sherry Wine to make 1000 mils. Filter
Carnis et Ferri	30 Gm. Extract of Beef; 60 mils Hot Water; 10 Gm. Iron and Ammonium Citrate; 100 mils Syrup; 50 mils Alcohol; 1 mil Compound Spirit of Orange; Ammonia Water and Sherry Wine, each, enough to make 1000 mils	Dissolve the Extract of Beef in the Hot Water and add the Syrup and the Spirit and Alcohol, mixed. Dissolve the Iron and Ammonium Citrate in 750 mils of Sherry Wine, mix this with the solution first made, add Ammonia Water until neutral or faintly alkaline and then enough Wine to make 1000 mils and filter after 2 days
Colchici Seminis	100 mils yields from 0.036 to 0.044 Gm. of Colchicine, 100 mils Fluidextract of Colchicum Seed; 150 mils Alcohol; 750 mils Sherry Wine	Mix them and filter after standing 2 days. Standardized by assay
Ferri	40 Gm. Iron and Ammonium Citrate; 60 mils Tincture of Sweet Orange Peel; 100 mils Syrup; Sherry Wine, enough to make 1000 mils	Dissolve the salt in 700 mils of Sherry Wine; then add the Tincture, Syrup, and enough Wine to make 1000 mils. Filter after standing 2 days
Ferri Amarum	50 Gm. Iron and Quinine Citrate; 60 mils Tincture of Sweet Orange Peel; 300 mils Syrup; Sherry Wine, enough to make 1000 mils	Dissolve the salt in 500 mils of Sherry Wine. Then add the Tincture, Syrup, and enough Wine to make 1000 mils. Filter after standing 2 days
Ipecacuanhæ	100 mils yields from 0.180 to 0.220 Gm. of the alkaloids of Ipecac; 100 mils Fluidextract of Ipecac; 100 mils Alcohol; 800 mils Sherry Wine	Mix them and filter after standing 2 days, Standardized by assay
Pepsini	200 mils Glycerite of Pepsin; 100 mils Alcohol; 700 mils Sherry Wine	Mix the Alcohol and Wine, and add the Glycerite. It should be freshly prepared
Picis	100 Gm. Tar; 250 mils Water; 125 Gm. Pumice; Alcohol and Sherry Wine, each, enough to make 1000 mils	Pour 250 mils of cold Water on the Tar, mix thoroughly and discard the Water. Mix the washed Tar with the Pumice, add 125 mils of Alcohol mixed with 875 mils of Sherry Wine, stir frequently during 4 hours and filter. Finally add enough of the Alcohol and Wine mixture to make 1000 mils
Pruni Virginianæ Ferratum	80 mils Tincture of Ferric Citro-Chloride; 920 mils Wine of Wild Cherry	Mix and filter after standing several days
Rhei Compositum	80 mils Fluidextract of Rhubarb; 20 mils Fluidextract of Bitter Orange Peel; 80 mils Tincture of Cardamom; 125 Gm. Sugar; Sherry Wine, enough to make 1000 mils	Mix the Fluidextracts and Tincture with 700 mils of Sherry Wine, dissolve the Sugar in the mixture, add enough Wine to make 1000 mils and filter
Made by Maceration or Percolation		
Vinum Aurantii Compositum	200 Gm. Bitter Orange Peel; 65 Gm. Absinthium; 65 Gm. Menyanthes; 65 Gm. Cascarilla; 43 Gm. Saigon Cinnamon; 43 Gm. Gentian; 10 Gm. Potassium Carbonate; Sherry Wine, enough to make 1000 mils	Macerate the drugs and Potassium Carbonate, with enough Sherry Wine to moisten, macerate during 24 hours, then percolate with Sherry Wine to make 1000 mils

Wines of the N. F. IV.

Title.	Ingredients	Method of Preparation
Made by Maceration or Percolation *Continued*		
Vinum Colchici Cormi	100 mils yields from 0.126 to 0.154 Gm. Colchicine; 400 Gm. Colchicum Corm; 150 mils Alcohol; Sherry Wine, a sufficient quantity	Percolate the drug with a mixture of the Alcohol, and 850 mils of Sherry Wine, followed with Wine, if necessary, until the percolate measures 900 mils. Then assay and adjust the product to contain 0.14 Gm. of Colchicine in 100 mils
Fraxini (White Ash)	500 Gm. White Ash Bark; Alcohol and Sherry Wine, each, enough to make 1000 mils	Macerate the drug for 3 days in 750 mils of a mixture of 125 mils of Alcohol and 875 mils of Sherry Wine. Then percolate with menstruum of the same strength until the product measures 1000 mils
Pruni Virginianæ	250 Gm. Wild Cherry; 200 mils Water; 100 mils Alcohol; 165 Gm. Sugar; 15 Gm. Purified Talc; Sherry Wine, enough to make 1000 mils	Macerate the drug in a covered vessel with the Water during 4 hours, then pack in a percolator, pour on a mixture of the Alcohol with 650 mils of Sherry Wine and when it drops close and macerate the drug for 12 hours. Then percolate until the product measures 900 mils, dissolve the Sugar in the percolate, incorporate the Talc, filter, and add enough Sherry Wine to make 1000 mils

VINUM ANTIMONII. N. F. Wine of Antimony

(Replacing U. S. P. VIII)

[Vin. Antimon.]

	Metric	Old form
Antimony and Potassium Tartrate	**4 Gm.**	58 gr.
Boiling Distilled Water	**25 mils**	384 min.
Sherry Wine, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the antimony and potassium tartrate in the boiling distilled water. Add this solution to 725 mils [old form about 23 fl. oz.] of sherry wine; mix well, and allow the mixture to stand until it has cooled. Then add sufficient sherry wine to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—15 minims (1 mil).

VINUM AURANTII COMPOSITUM. N. F. Compound Wine of Orange

[Vin. Aurant. Co. Elixir Aurantiorum Compositum Compound Elixir of Orange]

	Metric	Old form
Bitter Orange Peel, in No. 40 powder	**200 Gm.**	6 oz. av. 296 gr.
Absinthium, in No. 40 powder	**65 Gm.**	2 oz. av. 74 gr.
Menyanthes, in No. 40 powder	**65 Gm.**	2 oz. av. 74 gr.
Cascarilla, in No. 40 powder	**65 Gm.**	2 oz. av. 74 gr.
Saigon Cinnamon, in No. 40 powder	**43 Gm.**	1 oz. av. 190 gr.
Gentian, in No. 40 powder	**43 Gm.**	1 oz. av. 190 gr.
Potassium Carbonate	**10 Gm.**	146 gr.
Sherry Wine, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the vegetable drugs with the potassium carbonate, saturate the mixture with sherry wine and allow it to macerate during twenty-four hours. Then percolate with sherry wine, in the usual manner, until the product measures 1000 mils [old form 2 pints].

Average dose.—1 fluidrachm (4 mils).

VINUM CARNIS. N. F. Wine of Beef
[Vin. Carn. Beef and Wine]

	Metric	Old form
Extract of Beef	**30 Gm.**	1 oz. av.
Water, hot	**60 mils**	1 fl. oz. 442 min.
Syrup	**100 mils**	3 fl. oz. 96 min.
Alcohol	**50 mils**	1 fl. oz. 288 min.
Compound Spirit of Orange	**1 mil**	15 min.
Sherry Wine, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the extract of beef in the hot water, add the syrup, then the compound spirit of orange and the alcohol, previously mixed, and sufficient sherry wine to make the product measure 1000 mils [old form 2 pints]. Set the preparation aside for two days, and filter.

Average dose.—2 fluidrachms (8 mils).

VINUM CARNIS ET FERRI. N. F. Wine of Beef and Iron
[Vin. Carn. et Ferr. Beef, Wine and Iron]

	Metric	Old form
Extract of Beef	**30 Gm.**	1 oz. av.
Water, hot	**60 mils**	1 fl. oz. 442 min.
Iron and Ammonium Citrate	**10 Gm.**	146 gr.
Syrup	**100 mils**	3 fl. oz. 96 min.
Alcohol	**50 mils**	1 fl. oz. 288 min.
Compound Spirit of Orange	**1 mil**	15 min.
Ammonia Water,		
Sherry Wine, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the extract of beef in the hot water, add the syrup, then the compound spirit of orange and the alcohol, previously mixed. Dissolve the iron and ammonium citrate in 750 mils [old form 24 fl. oz.] of sherry wine, add this solution to the mixture just prepared, render the resulting product neutral or very faintly alkaline to litmus by the addition of ammonia water, and then add enough sherry wine to make the product measure 1000 mils [old form 2 pints]. If the liquid is now acid to litmus, add ammonia water, drop by drop, until it is again neutral or very faintly alkaline. Set the preparation aside for two days and filter.

Average dose.—2 fluidrachms (8 mils).

VINUM COLCHICI CORMI. N. F. Wine of Colchicum Corm
[Vin. Colchic. Corm.]

One hundred milliliters of Wine of Colchicum Corm yields not less than 0.126 Gm. nor more than 0.154 Gm. of colchicine.

	Metric	Old form
Colchicum Corm, in No. 30 powder	**400 Gm.**	13 oz. av. 154 gr.
Alcohol	**150 mils**	4 fl. oz. 384 min.
Sherry Wine, a sufficient quantity,		
To make about	**1000 mils**	2 pints

Mix the alcohol with 850 mils [old form 27 fl. oz. 96 minims] of sherry wine. Moisten the powder with 100 mils [old form about 3¼ fl. oz.]

of the menstruum, pack it moderately in a conical percolator, and gradually pour upon it, first, the remainder of the menstruum, and afterwards enough sherry wine to make the product measure 900 mils [old form about 28½ fl. oz.]. Assay 40 mils of the liquid, as directed below, and from the result thus obtained ascertain by calculation the amount of colchicine in the remainder of the liquid, and adjust this so that each 100 mils of the Wine contains 0.14 Gm. of colchicine.

Assay.—Evaporate 40 mils of Wine of Colchicum Corm to 15 mils and proceed as directed under *Fluidextractum Colchici Cormi*, rinsing the dish with a portion of the water there directed.

Average dose.—10 minims (0.6 mil).

VINUM COLCHICI SEMINIS. N. F. Wine of Colchicum Seed
(U. S. P. VIII)
[Vin. Colch. Sem.]

One hundred milliliters of Wine of Colchicum Seed yields not less than 0.036 Gm. nor more than 0.044 Gm. of colchicine.

	Metric	Old form
Fluidextract of Colchicum Seed	**100 mils**	3 fl. oz. 96 min
Alcohol	**150 mils**	4 fl. oz. 384 min.
Sherry Wine	**750 mils**	24 fl. oz.
To make	**1000 mils**	2 pints

Mix them. Set the mixture aside for two days and then filter.

Assay.—Evaporate 150 mils of Wine of Colchicum Seed to 15 mils and proceed as directed under *Fluidextractum Colchici Cormi*.

Average dose.—30 minims (2 mils).

VINUM FERRI. N. F. Wine of Iron
(U. S. P. VIII)
[Vin. Ferr. Wine of Citrate of Iron]

	Metric	Old form
Iron and Ammonium Citrate	**40 Gm.**	1 oz. av. 147 gr.
Tincture of Sweet Orange Peel	**60 mils**	1 fl. oz. 442 min.
Syrup	**100 mils**	3 fl. oz. 96 min.
Sherry Wine, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the iron and ammonium citrate in 700 mils (old form about 22½ fl. oz.] of sherry wine. Add to this the tincture of sweet orange peel and the syrup, and, lastly, enough sherry wine to make the product measure 1000 mils [old form 2 pints]. Set the mixture aside for two days and then filter.

Average dose.—2 fluidrachms (8 mils).

VINUM FERRI AMARUM. N. F. Bitter Wine of Iron
(U. S. P. VIII)
[Vin. Ferr. Amar.]

	Metric	Old form
Iron and Quinine Citrate	**50 Gm.**	1 oz. av. 293 gr.
Tincture of Sweet Orange Peel	**60 mils**	1 fl. oz. 442 min.
Syrup	**300 mils**	9 fl. oz. 288 min.
Sherry Wine, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the iron and quinine citrate in 500 mils [old form 1 pint] of sherry wine. Add to this the tincture of sweet orange peel and the syrup, and, lastly, sufficient sherry wine to make the product measure 1000 mils [old form 2 pints]. Set the mixture aside for two days and then filter.

Average dose.—2 fluidrachms (8 mils).

VINUM FRAXINI. N. F. Wine of White Ash
[Vin. Frax.]

	Metric	Old form
White Ash Bark, in No. 40 powder	**500 Gm.**	16 oz. av. 302 gr.
Alcohol,		
Sherry Wine, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix 125 mils [old form 4 fl. oz.] of alcohol with 875 mils [old form 28 fl. oz.] of sherry wine and macerate the bark in 750 mils [old form 24 fl. oz.] of the mixture in a covered vessel, during three days, then transfer it to a percolator and allow the liquid to drain off. When completely drained, pack the residue firmly, and gradually pour on sufficient menstruum of the same kind until the product measures 1000 mils [old form 2 pints]. Filter the wine and keep it in well-stoppered bottles, which should be completely filled, and stored in a cool place.

Average dose.—1 fluidrachm (4 mils).

VINUM IPECACUANHÆ. N. F. Wine of Ipecac
(U.S.P. VIII)
[Vin. Ipecac.]

One hundred milliliters of Wine of Ipecac yields not less than 0.180 Gm. nor more than 0.220 Gm. of the alkaloids from ipecac.

	Metric	Old form
Fluidextract of Ipecac	**100 mils**	3 fl. oz. 96 min.
Alcohol	**100 mils**	3 fl. oz. 96 min.
Sherry Wine	**800 mils**	25 fl. oz. 288 min.
To make	**1000 mils**	2 pints

Mix them. Set the mixture aside for two days and then filter through paper in a well-covered funnel.

Assay.—Evaporate 100 mils of Wine of Ipecac to 10 mils, add 10 Gm. of purified sawdust (see Chapter LXII), and evaporate it to dryness at a temperature not exceeding 80° C. (176° F.). Transfer the impregnated sawdust to a 250-mil flask and add 100 mils of ether. Rinse the dish in which the mixture was evaporated with 6 mils of ammonia water, previously diluted with an equal volume of distilled water, used in several portions, and add the rinsings to the flask. Stopper the flask and shake it vigorously every few minutes during two hours. Now add 15 mils of distilled water, again shake the flask well and, when the sawdust has subsided, decant 50 mils of the ether solution, representing 50 mils of the Wine. Completely extract the alkaloids from this solution by shaking out with weak sulphuric acid. Collect the acid washings in a separator; add ammonia water until the solution is decidedly alkaline to litmus and completely extract the alkaloids by shaking out repeatedly with ether. Evaporate the combined ether washings to dryness, dissolve the alkaloid from the residue in exactly 10 mils of tenth-normal sulphuric acid V.S. and titrate the excess of acid with fiftieth-normal potassium hydroxide V.S., cochineal T.S. or methyl red T.S. being used as indicator.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 24 milligrammes of the ether-soluble alkaloids of ipecac.

Average dose.—15 minims (1 mil).

VINUM PEPSINI. N. F. Wine of Pepsin
[Vin. Pepsin. Pepsin Wine]

	Metric	Old form
Glycerite of Pepsin	**200 mils**	6 fl. oz. 192 min.
Alcohol	**100 mils**	3 fl. oz. 96 min.
Sherry Wine	**700 mils**	22 fl. oz. 192 min.
To make	**1000 mils**	2 pints

Mix the alcohol with sherry wine, then add the glycerite, and mix thoroughly. This preparation should not be dispensed unless it has been recently prepared.

Average dose.—2 fluidrachms (8 mils).

VINUM PICIS. N. F. Wine of Tar
[Vin. Pic.]

	Metric	Old form
Tar	**100 Gm.**	3 oz. av. 148 gr.
Water	**250 mils**	8 fl. oz.
Pumice, in moderately fine powder	**125 Gm.**	4 oz. av. 76 gr.
Alcohol,		
Sherry Wine, each, a sufficient quantity,		
To make	**1000 mils**	2 pints

Upon the tar, contained in a suitable vessel, pour 250 mils [old form 8 fl. oz.] of cold water, and stir the mixture thoroughly; then pour off the water and throw it away. Mix the washed tar thoroughly with the powdered pumice, and add 1000 mils [old form 2 pints] of a mixture of 125 mils [old form 4 fl. oz.] of alcohol and 875 mils [old form 28 fl. oz.] of sherry wine. Stir the mixture frequently during four hours, then transfer it to a wetted filter, and, after the magma has drained, pour on a sufficient quantity of the alcohol and wine mixture, prepared as before, to make the filtrate measure 1000 mils [old form 2 pints].

Average dose.—2 fluidrachms (8 mils).

VINUM PRUNI VIRGINIANÆ. N. F. Wine of Wild Cherry
[Vin. Prun. Virg.]

	Metric	Old form
Wild Cherry, in No. 40 powder	**250 Gm.**	8 oz. av. 151 gr.
Water	**200 mils**	6 fl. oz. 192 min.
Alcohol	**100 mils**	3 fl. oz. 96 min.
Sugar	**165 Gm.**	5 oz. av. 222 gr.
Purified Talc	**15 Gm.**	219 gr.
Sherry Wine, a sufficient quantity,		
To make	**1000 mils**	2 pints

Moisten the wild cherry with the water and transfer it to a percolator, and allow the percolator to remain well covered for three or four hours; then pack the moistened wild cherry moderately and pour on sufficient of a mixture of 100 mils [old form 3 fl. oz. 96 minims] of alcohol and 650 mils [old form 20 fl. oz. 384 minims] of cherry wine to leave a stratum above the wild cherry. When the liquid begins to drop, close the lower orifice, and continue the maceration for twelve hours. Then allow the percolation to proceed slowly, gradually adding the remainder of the mixture of alcohol and wine, followed by sufficient sherry wine

to make the percolate measure 900 mils [old form about 28½ fl. oz.]. In this dissolve the sugar, add the purified talc and mix thoroughly; then filter, returning the first portion of the filtrate until it runs through clear, and pass sufficient sherry wine through the filter to make the product measure 1000 mils [old form 2 pints].

N. F. Preparation.—Vinum Pruni Virginianæ Ferratum.

Average dose.—1 fluidrachm (4 mils).

VINUM PRUNI VIRGINIANÆ FERRATUM. N. F. **Ferrated Wine of Wild Cherry**

[Vin. Prun. Virg. Ferr.]

	Metric	Old form
Tincture of Ferric Citro-Chloride	**80 mils**	2 fl. oz. 269 min.
Wine of Wild Cherry	**920 mils**	29 fl. oz. 211 min.
To make	**1000 mils**	2 pints

Mix; allow the mixture to stand for several days and then filter.

Average dose.—1 fluidrachm (4 mils).

VINUM RHEI COMPOSITUM. N. F. **Compound Wine of Rhubarb**

[Vin. Rhei Co. Tinctura Rhei Vinosa, N. F. III]

	Metric	Old form
Fluidextract of Rhubarb	**80 mils**	2 fl. oz. 269 min.
Fluidextract of Bitter Orange Peel	**20 mils**	307 min.
Tincture of Cardamom	**80 mils**	2 fl. oz. 269 min.
Sugar	**125 Gm.**	4 oz. av. 76 gr.
Sherry Wine, a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix the fluidextracts and the tincture with 700 mils [old form 22 fl. oz. 192 minims] of sherry wine. In this dissolve the sugar by agitation, then add sufficient sherry wine to make the product measure 1000 mils [old form 2 pints] and filter.

Average dose.—1 fluidrachm (4 mils).

Unofficial Wines

Title	Ingredients	Method of Preparation
Vinum Aurantii. Br.	Wine, containing 12 to 14 per cent. by volume of Alcohol and flavored by Bitter Orange Peel	Obtained from the fermentation of a saccharine solution to which Fresh Bitter Orange Peel has been added
Quininæ. Br.	2 Gm. Quinine Hydrochloride; 875 mils Orange Wine	Dissolve the Quinine Hydrochloride in the Orange Wine and filter if necessary

Fluidextracta *Fluidextracts*

Fluidextracts are liquid alcoholic preparations of uniform and definite strength, made by percolating drugs with menstrua, and concentrating a portion of the percolate so that in each case a mil represents the medicinal virtues of one gramme of the drug; they are mostly concentrated tinctures. Fluidextracts were official for the first time in 1850, and the list was then made up of *seven* concentrated preparations,

although but *one* of these could be called a fluidextract within the present meaning of the term; of the seven, two were oleoresins, four were concentrated syrups, and but one was a concentrated tincture. Since 1850 the use of fluidextracts has increased to an enormous extent; the U. S. P. IX contains formulas for *forty-nine* and the N. F. IV for *ninety* preparations belonging to this class. Fluidextracts may be justly called "American preparations," and the advance made in pharmacy in this country within the last quarter of a century is largely due to the stimulus given by the studies in percolation and the demand for these useful liquids. The striking advantages possessed by fluidextracts are: 1. Permanence. 2. Concentration. 3. The uniform relation existing between the fluidextract and the drug.

In the U. S. P. 8th Revision, one word, "Fluidextractum," was first adopted in place of two words, "Extractum Fluidum," formerly used. The object of this change was to avoid the confusion heretofore existing due to the alphabetical arrangement, which compelled Fluidextracts to be printed with the Extracts; thus, "Extractum Rhei" had to be followed by "Extractum Rhei Fluidum." By making the Latin name for fluidextracts "Fluidextractum," these preparations are now under the letter F instead of E. The English name is, of course, "Fluidextract" instead of "Fluid Extract."

Permanence is secured by the use of alcoholic menstrua; formerly, sugar and glycerin were relied upon as preservatives, but continued experience has developed the value of alcohol, so that at present it is most largely used as the solvent. Glycerin, however, is used in the menstruum of some fluidextracts, notably those containing tannin, and has a tendency to retard precipitation.

Concentration enables the physician to decrease the bulk of the dose, diminishing the volume of the preparation so that portability is secured and any therapeutic action from the menstruum largely eliminated. It also aids greatly in securing permanence.

The uniform relation existing between the fluidextract and the drug is of great assistance to the physician in fixing the dose, because, as one mil represents one gramme of drug, the dose of the fluidextract must be practically the same as that of the drug. It has also obvious advantages in the arrangement of the formulas and in working from them. The present strength of fluidextracts renders them five per cent. weaker than the fluidextracts of the U. S. P. 1870; this is practically of no significance, so long as the drugs themselves are not brought to a standard limiting the amount of moisture or active principles present, for there would be more variation than five per cent. between different lots of the same drugs, in these particulars; indeed, the proposition to make fluidextracts just half their present strength has met with favor from many able pharmacists, the principal arguments being that more thorough exhaustion can be secured by the ordinary operator upon the small scale, and that the fluidextracts can be made to represent the drug more accurately and honestly when *one hundred* parts by measure are made from *fifty* parts by weight of the drug than when one hundred parts by measure are made from one hundred parts by weight of the drug. The standard of strength of the official fluidextracts is based upon the theory that from a given weight of drug an amount of fluidextract shall be made equal in measure to the bulk of the same weight

of distilled water; in other words, the relation is that of gramme to mil.

Fluidextracts may be standardized whenever made from a drug capable of being assayed. Thirteen of the U. S. P. IX fluidextracts are standardized; they are as follows: Aconite, belladonna root, cannabis (biological assay required), cinchona, colchicum seed, digitalis (biological assay optional), guarana, hydrastis, hyoscyamus, ipecac, nux vomica, pilocarpus, squill (biological assay optional). *Four* of the N. F. IV fluidextracts are assayed; they are aqueous fluidextract of cinchona and fluidextracts of colchicum corm, conium, and stramonium.

Preparation.—Fluidextracts are made in several ways. The manufacturer generally adopts a different process from that directed by the Pharmacopœia, because upon the large scale some practical modifications are necessary; the finished preparation should, however, be brought to the official standard. The processes at present in use may be classified as follows: 1. Percolation with partial evaporation. 2. Percolation with incomplete exhaustion. 3. Repercolation or "fractional percolation." 4. Continuous percolation. 5. Vacuum maceration with percolation. 6. Hot water exhaustion, evaporation and preservation.

1. **Percolation and Partial Evaporation.**—This process is well illustrated by the official Type Process A and B as follows:

"*Type Process A.*—Moisten 1000 Gm. [old form 50 oz. av.] of the powdered drug directed with a sufficient quantity of the prescribed menstruum to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum, until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate (unless otherwise specified in the formula), recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints] or the volume determined by calculation from the assay.

"*Type Process B.*—Moisten 1000 Gm. [old form 50 oz. av.] of the powdered drug directed with a sufficient quantity of the prescribed Menstruum I to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator, add the remainder of Menstruum I, and, when this has just disappeared from the surface, gradually add Menstruum II, constantly maintaining a stratum of liquid above the drug. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours, and then allow the percolation to proceed slowly, gradually adding Menstruum II until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate (unless otherwise specified in the formula); recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not

exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of Menstruum II to obtain 1000 mils (old form 3 pints), or the volume determined by calculation from the assay."

The precipitation experienced heretofore when the evaporated weak percolate was added to the reserved portion is considerably diminished by causing the former to be evaporated to a soft extract. This precipitation, formerly noticed more particularly in alcoholic fluidextracts, was due to the volatility of the alcohol in the weak percolates, which, when evaporated, left the residue to a great extent aqueous; when this residue was added to the strongly alcoholic reserved portion, a precipitation of resinous and frequently of active matter took place, which necessitated the storing of the fluidextract until precipitation ceased, and subsequent filtration. This is almost altogether avoided by evaporating to a soft extract, and the loss of activity through precipitation is thus greatly diminished.

The argument is frequently advanced that the application of heat is detrimental to solutions of organic principles, that it dissociates some, and always proves injurious to the desirable constituents, *and that no heat whatever should be used in making fluidextracts;* these views are undoubtedly correct, when considered in connection with a few special cases, but do not apply with any practical force to the moderate use of heat where recommended by the official processes upon that portion of the percolate which represents the least active and least desirable constituents of the drug, for from seven-tenths to nine-tenths of the whole amount of percolate (frequently representing ninety-five per cent. of the activity of the drug) is reserved and is not subjected to heat at all. The official process of "fractional percolation" may, however, be applied to any fluidextract directed to be made by Type Process A and by this method the application of all heat is avoided.

2. **Percolation with Incomplete Exhaustion.**—This process consists in percolating a given weight of a drug with the proper menstruum in the usual manner, and stopping the percolation when an amount of percolate has been received which is equal to about three-fourths of the weight of the drug, any active constituents which may remain in the drug being sacrificed. This method has the merit of saving time and labor, and avoiding evaporation with the necessary contact with heat. It is based on the assumption that when percolation is properly conducted the first seventy-five per cent. of percolate received contains at least seventy-five per cent. of the soluble and desirable principles of the drug, and that the wastage of alcohol comes chiefly from the effort to obtain the last twenty-five per cent. or less of soluble principles. In addition, this smaller amount of extractive matter in the weak percolate is said to be lessened in activity by the effects of the heat during the evaporation to recover the alcohol from it; hence the argument that in carefully conducted operations the active matter left after receiving the percolate, representing seventy-five per cent. of the drug, does not represent twenty-five per cent. of activity, but oftentimes less than ten per cent. The principal disadvantage of this method is that the *strength* of the finished fluidextract depends *entirely* upon the *skill* and *care* of the operator. If careful, in one operation seventy-five per cent. of the active principles may be obtained in

the first seventy-five per cent. of percolate; in another case circumstances may prevent the extraction of more than fifty per cent. of the active principles in the first seventy-five per cent. of percolate. By this method of making fluidextracts uniformity cannot invariably be secured, while in making fluidextracts by the official process a valuable check always exists—*i.e., that percolation proceeds until exhaustion is reached, the weak percolate is evaporated at a limited temperature, and the soft extract is incorporated with the reserved portion,* so that imperfect percolation happening in the first part of the process is compensated for in the latter part, the only difference being that the weak percolate in this case contains a larger proportion of activity than if the operation had been thoroughly conducted from the first.

3. **Repercolation or "Fractional Percolation."**—This process, already considered under the head of percolation (see page 298), is an improvement upon the method just noticed, because by this method the drug is percolated to exhaustion, and evaporation obviated by storing the weak percolate until the next operation upon the same drug, when it is used instead of fresh menstruum. This process may be best explained by selecting a typical fluidextract and noting the details.

Fluidextract of Cinchona by Repercolation (Squibb).—Take of Yellow Cinchona, in No. 50 powder, 32 parts; Alcohol, 2 parts; Glycerin, 1 part; Water, 2 parts, or a sufficient quantity.

Prepare the menstruum by weighing the Alcohol, Glycerin, and Water in succession, in any convenient quantity at a time, into a tared bottle, and mixing them thoroughly.

Moisten 8 parts of the Cinchona with 8 parts of the menstruum, by thoroughly mixing them, and allow the mixture to stand eight hours in a closely-covered vessel. Then pass the moist powder through a No. 8 sieve, and pack it firmly in a percolator. Pour menstruum on top until the mass is filled with liquid and a stratum remains on top unabsorbed; cover the percolator closely, and macerate for forty-eight hours. Then arrange the percolator for an automatic supply of menstruum, and start the percolation at such a rate as to give 1 part of percolate in about four hours. Reserve the first 6 parts of percolate, and continue the percolation until the Cinchona is exhausted, separating the percolate received after the reserved portion into fractions of about 8 parts each.

Moisten a second portion of 8 parts of the Cinchona with 8 parts of the weak percolate—the first portion that was obtained next after the reserved percolate—and allow the moist powder to stand for eight hours in a vessel closely covered. Then pack it moderately in a percolator, and supply the percolator automatically with the remaining fractions of the weak percolate in the order in which they were received, and finally with fresh menstruum, until the Cinchona is exhausted. Percolate in the same manner and at the same rate as with the first portion of Cinchona, and, reserving 8 parts of the first percolate, separate the weaker percolate into fractions of about 8 parts each. Percolate the third and fourth portions of 8 parts each of the Cinchona in the same way as the second portion.

Finally, mix the four reserved percolates to make 30 parts of finished fluidextract; and, having corked, labelled, and numbered the bottles containing the fractions of weak percolate, set them away until the process for Cinchona is to be resumed.

When this fluidextract is to be again made, repeat the process as with the second portion, and reserve 8 parts of the first percolate as finished fluidextract from each 8 parts of Cinchona from that time forward so long as the fractions of weak percolate are carried forward with which to commence each operation.

The U. S. P. IX has introduced a process similar to repercolation, as suggested by Prof. C. Lewis Diehl. This method is well adapted for certain fluidextracts which are readily injured by heat. It is used in the Pharmacopœia for the fluidextracts of aconite and bitter orange peel and aromatic fluidextract, and in the N.F. IV for fluidextract of conium. It is also recommended for any fluidextract ordinarily made by Type Process A. The details of the process are as follows:

"*Type Process C.*—Divide 1000 Gm. [old form 50 oz. av.] of the powdered drug directed into three portions of 500 Gm., 300 Gm., and 200 Gm. [old form 25 oz. av., 15 oz. av., and 10 oz. av.], respectively. Moisten the first portion of the drug (500 Gm. [old form 25 oz. av.]) with a sufficient quantity of the prescribed menstruum to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours and then allow the percolation to proceed slowly, gradually adding more of the menstruum. Reserve the first 200 mils [old form 9 fl. oz. 288 min.] of percolate and continue the process until the additional percolate measures 1500 mils [old form about 4½ pints], the latter being collected in successive portions of 300 mils [old form about 14½ fl. oz.] each.

"Moisten the second portion of the powdered drug (300 Gm. [old form about 15 oz. av.]) with a sufficient quantity of the percolate collected in the preceding operation, immediately after the reserved portion, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and macerate and percolate as directed for the first part of the drug, using as menstruum the several portions of percolate from the preceding operation in the order in which they have been collected, and, if this be insufficient, follow with some of the original menstruum. Reserve the first 300 mils [old form 14 fl. oz. 192 min.] of percolate and continue the process until the additional percolate measures 800 mils [old form about 38½ fl. oz.], collecting the weaker percolate in successive portions of 200 mils [old form about 9½ fl. oz.] each.

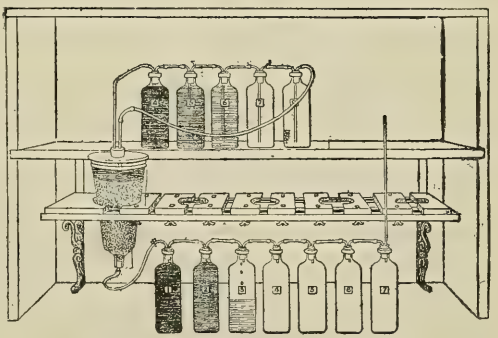
"Moisten the third portion of the powdered drug (200 Gm. [old form 10 oz. av.]) with a sufficient quantity of the percolate collected in the preceding operation, immediately after the reserved portion, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and macerate and percolate as before, using as menstruum the several portions of percolate from the preceding operation in the order in which they have been collected, and, if this be insufficient, follow with more of the original menstruum. Collect 500 mils [old form 1½ pints] of percolate and mix this with the two

portions previously reserved so as to make 1000 mils [old form 3 pints] of finished fluidextract.

"When Type Process C is directed for fluidextracts which are adjusted by assay to a definite alkaloidal standard, collect only 420 mils [old form 20 fl. oz. 77 min.] of percolate from the third portion of drug instead of the 500 mils [old form 1½ pints] directed above. Mix this percolate with the two portions previously reserved, assay a portion of the mixture and then adjust its volume, by the addition of the menstruum directed, so that each 100 mils of finished fluidextract will contain the prescribed amount of alkaloid."

4. **Continuous Percolation.**—Robert W. Beck has devised a modification of Dr. Squibb's method of repercolation with a view of rendering the process more suitable for the smaller operations carried on by retail pharmacists. The storing away of the last weak percolates, and particularly the necessity for collecting the fractions of percolates, have operated to prevent repercolation from being used in small operations to the extent that it would be otherwise. Mr. Beck has sought to remove some of these disadvantages, and the illustration shown in Fig. 437 serves to render the explanations which follow more easily understood. His process and apparatus effect a saving in time and attention, and the difficulty of keeping the percolators containing the drugs supplied with the proper menstruum at the time when the portion previously added has just disappeared has been overcome; the watchfulness necessary to see that each receiving vessel does not overflow, or get more than its due proportion of the weaker percolate or menstruum, is reduced to a minimum, and the constant changing of receiving bottles is no longer required.

FIG. 437



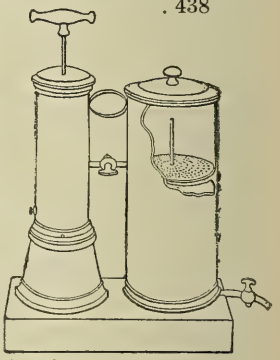
Beck's continuous percolation method

The percolate is carried from one receiving bottle, when full, to the next one by tubes inserted in the corks from the neck of one bottle to the neck of the other. Very little diffusion occurs, owing to the fact that the heavier liquids are drawn off first, and in each case a lighter liquid is deposited slowly (by drops) upon a denser one; as the same principle is employed in receiving the percolates, the bottle nearest the percolator is filled with very dense percolate, and when the bottle is as full as desired, the tube connecting with the next bottle draws off the light liquid as it is deposited on top, and practically no intermixture occurs. Of course, the same action takes place in the remaining bottles of the series. If desired, the reserve or strongest percolate or finished fluidextract contained in the first bottles of the series can be removed, their place being supplied by empty bottles, so that even the slight risk of diffusion would apply only to weak percolates. In Fig. 437 the percolator is connected with No. 1 bottle by a rubber tube having a pinch-

cock to regulate the flow; the remaining bottles are all connected in proper order by means of glass tubes and rubber tubing, as shown, the ends of the glass tubes being adjusted so as to be on the same level. When No. 1 bottle is full of dense percolate No. 2 bottle begins to fill with weaker percolate, then No. 3 with still weaker percolate, and so on. From the top of the last bottle on the upper shelf (No. 8) a piece of rubber tubing is connected with a glass tube having an inside diameter of ¼ inch, which passes through the cover of the percolator, the lower end about ⅛ inch above the surface of the drug. This device makes an automatic supply of menstruum, the latter ceasing to flow when the liquid rises in the percolator above the end of the supply tube.

5. **Vacuum Maceration Followed by Percolation.**—This method of making fluidextracts was proposed in 1869 by S. P. Duffield. His original process was to introduce the drug, ground to the requisite fineness, into a strong cylinder connected with an airpump. The air was exhausted by the pump, and through a syphon tube the requisite amount of menstruum was sucked into the vacuum chamber. The air enclosed in the interstices and pores of the drug was thus expelled, and, the menstruum being brought immediately in contact with the soluble constituents, maceration was facilitated. The same process was suggested by Needles many years ago. Fig. 438 is an illustration of his original apparatus, the vessel upon the right hand being the percolator and receiver, the pump for exhausting the receiver being connected by a short tube carrying a stopcock. The most effective apparatus known to the author for using this principle upon the large scale is that devised by Wm. M. Thomson of Philadelphia, and illustrated in the *American Journal of Pharmacy*, page 237, 1882. The percolators are egg shaped, and made of tinned copper; they are capable of being tightly covered, and communicate with a very efficient double-acting airpump by means of stopcocks above and below, and iron and stout rubber tubing. The moistened powder is packed tightly in the percolator, and the cover securely bolted on. The stopcock in the cover, communicating with the airpump, is opened, and a partial vacuum created in the space above the moistened drug; it is then closed, and another stopcock in the cover opened, which communicates by a tube with the reservoir containing the menstruum. The menstruum quickly penetrates the powder, taking the place of the interstitial air, and when the powder is saturated it is permitted to macerate *in vacuo* a sufficient length of time. To start percolation, a receiver is connected with the beak of the percolator, and the air exhausted from it. When the flow slackens, air may be forced by the pump into the space above the powder, and the receiver again exhausted below. In this way entire control of these powerful physical forces may be secured. The advantages are apparent in preventing the loss of alcohol and protecting from chemical change caused by exposure to the air. It is quite possible to make an official fluidextract without recourse to the subsequent evaporation of weak percolate.

. 438



Needles's Vacuum Percolator

6. **Hot Water Exhaustion, Evaporation and Preservation.**—This method has been adopted for several official fluidextracts in which the active constituents are soluble in water. The making of fluidextracts by this process is very economical and may be used to advantage by retail pharmacists. It is directed in the U. S. P. IX for cascara sagrada, aromatic cascara sagrada, frangula and triticum. The process is as follows:

"*Type Process D.*—To 1000 Gm. [old form 50 oz. av.] of the ground drug add 5000 mils [old form 15 pints] of boiling water, mix thoroughly and allow it to macerate in a covered container for two hours in a warm place. Then transfer the moist drug to a tinned or enameled metallic percolator and allow percolation to proceed, gradually adding boiling water until the drug is exhausted. Evaporate the percolate on a water bath or steam bath to the volume specified and when cold add the alcohol directed and mix thoroughly."

Preservation of Fluidextracts.—Very little trouble is experienced in keeping fluidextracts which have been properly made. The Pharmacopœia directs that they "should be kept in tightly-stoppered containers for one month and then, if perfectly clear, they should be stored in amber-colored bottles protected from sunlight and extremes of temperature. If sedimentation has occurred, the clear portion should be decanted, the remainder filtered and the liquids thoroughly mixed together before storing"; precipitation to a greater or less extent will certainly take place. This is often especially noticeable in fluidextracts made during warm weather, and is due to the greater solvent action of the menstruum at higher temperatures. Precipitation is also caused by the variation in the strength of different portions of the menstruum in an alcoholic fluidextract; the first part of the percolate which is received contains the displaced water which was present as moisture in the powder, and the mixture of this with the strong alcoholic percolate which follows causes precipitation in time. The character of the precipitates should be ascertained; if active, they should be incorporated by shaking with the fluidextract; if inert, they should be filtered out.

Acetic Fluidextracts, or Fluidacetracts.—These were proposed by C. F. Squibb, and consist of preparations made like fluidextracts of definite strength (gramme for mil), but made with acetic acid or diluted acetic acid of various strengths. The advantages claimed for them are cheapness, permanence, and miscibility with aqueous liquids. The disadvantages which have been urged against their use are the presence of acetic acid, which is not always desirable, and the loading of the finished preparation with inert constituents for which acetic acid is a good solvent. It is obvious that this class of preparations is of value, but it is also clear that acetic acid is suited, on account of its great solvent and penetrating power, for extracting the soluble principles from certain drugs, but for others alcohol is to be preferred. The ideal menstruum for any drug is one which will extract the desirable principles and leave in the marc those which are not needed. In the Pharmacopœia of 1870 glycerin entered as a menstruum into nearly every fluidextract; experience showed, however, that it was unsuited for this purpose, because the fluidextract was loaded heavily with inert and useless principles which were dissolved in the glycerin. For oleoresinous drugs and those

containing resinous active principles the acetic acid used as a menstruum should range in strength from 36 per cent. to 90 per cent., while for drugs which do not contain these principles the acetic acid need not be stronger than from 6 to 10 per cent.

The antiseptic powers of acetic acid are well known, and where it is desirable to avoid the use of alcohol, fluidacetracts would supply an excellent substitute.

The fears which have been frequently expressed about the action of acetic acid when taken into the stomach have not been borne out by considerable experience with their use, because it must be remembered that the quantity of acetic acid entering the stomach in the small dose in which these concentrated preparations are administered would not be more than the quantity frequently used by patients with their food. The United States Pharmacopœia, Eighth Revision, contained several fluidextracts of this type, but they have not been continued in the Ninth Revision.

Fluidextracts from Green Drugs.—This class of preparations has been used to some extent, and they may be made by crushing the drug, obtaining the liquid by pressure, and adding alcohol or diluted alcohol, according to the nature of the drug, repressing, and making the final product represent one gramme in each mil. Owing to the varying proportion of water found in green drugs, it is evident that each preparation must be made from a special formula, and the quantity of alcohol to be added must depend upon the amount of water present in the drug; for drugs containing principles which are volatile or easily dissociated, this method produces good preparations, but unusual care must be exercised to secure uniformity.

Alcoholic Percentage of Fluidextracts.—The National Food and Drugs Act of 1906 requires that the percentage of alcohol by volume, in all preparations containing alcohol, be stated on the label. This must be determined for each lot of fluidextract because of the loss by evaporation during manufacture, variations in the amount of water in air-dried drugs, the absorption of moisture from the air, and the variable amounts of extractive in different lots of the same drug. The percentage of alcohol in finished fluidextracts is always less than that in the menstrua employed. This may be determined by the official method (see Chapter XLII).

U.S.P. IX Fluidextracts, arranged in Classes according to the Method of Preparation and Alcoholic Strength

Made by "**Type Process A**" (used for fluidextracts made with Alcoholic or Hydroalcoholic Menstruum). Moisten the powdered drug with sufficient of the prescribed menstruum, macerate for six hours in a tightly-closed container, then pack in a cylindrical percolator, pour on menstruum, and, when it drops, close the percolator and macerate for forty-eight hours. Then percolate until the drug is exhausted, setting aside the first 850 mils of percolate unless otherwise indicated. Evaporate the remaining percolate at 60° C. (140° F.) to a soft extract, dissolve this in the reserved portion and add enough menstruum to make 1000 mils. If the fluidextract is to be assayed the final volume is adjusted to contain the exact amount of active principle.

Title	Menstruum	Mils of Reserve	Remarks
	Alcohol		
Fluidextractum Buchu	"	850	
Cannabis	"	850	A biological assay required
Cimicifugæ	"	850	
Podophylli	"	850	
Staphisagriæ	"	850	Remove the oil from the freshly prepared product by chilling and filtering
Veratri Viridis	"	850	
Zingiberis	"	850	
	Alcohol, 5 **Water, 1**		
Fluidextractum Belladonnæ Radicis	" "	800	Assayed, 100 mils contains from 0.405 to 0.495 Gm. Belladonna alkaloids
Digitalis	" "	850	A biological assay optional
	Alcohol, 4 **Water, 1**		
Fluidextractum Eriodictyi	" "	800	
Gelsemii	" "	850	
Rhei	" "	850	
Sabal	" "	850	
Sumbul	" "	850	
	Alcohol, 3 **Water, 1**		
Fluidextractum Eucalypti	" "	800	
Grindeliæ	" "	850	
Guaranæ	" "	800	Assayed, 100 mils contains from 3.6 to 4.4 Gm. of Caffeine
Hyoscyami	" "	850	Assayed, 100 mils contains from 0.055 to 0.075 Gm. of Hyoscyamus alkaloids
Nucis Vomicæ	" "	800	Assayed, 100 mils contains from 2.37 to 2.63 Gm. of Nux Vomica alkaloids
Xanthoxyli	" "	850	
	Alcohol, 2 **Water, 1**		
Fluidextractum Colchici Seminis	" "	850	Assayed, 100 mils contains from 0.36 to 0.44 Gm. of Colchicine. Extract the fat from the drug by percolation with benzin before using the alcoholic menstruum
Pilocarpi	" "	800	Assayed, 100 mils contains from 0.55 to 0.65 Gm. of Pilocarpus alkaloids
Senegæ	" "	800	Add enough ammonia water to render the product slightly alkaline before adjusting the final volume
Viburni Prunifolii	" "	850	
	Diluted Alcohol		
Fluidextractum Gentianæ	" "	850	
Sarsaparillæ	" "	850	
Scillæ	" "	...	Special process (see page 558)
Spigeliæ	" "	850	
Stillingiæ	" "	850	
	Alcohol, 1 **Water, 2**		
Fluidextractum Sennæ	" "	800	

U.S.P. IX Fluidextracts—*Continued*

Made by "**Type Process B**" (used for fluidextracts in which the menstruum consists of Alcohol and Water, with the addition of Glycerin, Acid, or other solvent). For 1000 Gm. of drug prepare 1000 mils of menstruum containing the Glycerin or other solvent to be added to the Alcohol and Water and proceed as directed in Type Process A until this first 1000 mils of menstruum has all been used. Then prepare additional menstruum, but replace the Glycerin, Acid, or other solvent used with a corresponding amount of Water. The alcoholic per cent. remains the same throughout and the fluidextract is finished as directed under Type Process A.

Title	Menstruum I mils	Menstruum II	Mils of Reserve	Remarks
Fluidextractum Cinchonæ	Glycerin, 100 Dil. HCl, 100 Alcohol, 800	Alcohol, 4 Water, 1	850	Assayed, 100 mils contains from 4 to 5 Gm. of Cinchona alkaloids
Aspidospermatis	Glycerin, 110 Alcohol, 670 Water, 220	Alcohol, 2 Water, 1	850	
Hydrastis	Glycerin, 100 Alcohol, 600 Water, 200	Alcohol, 2 Water, 1	750	Assayed, 100 mils contains from 1.8 to 2.2 Gm. of ether-soluble alkaloids of Hydrastis
Granati	Glycerin, 100 Alcohol, 500 Water, 400	Dil. Alcohol	850	
Rosæ	Glycerin, 100 Alcohol, 500 Water, 400	Dil. Alcohol	850	
Sarsaparillæ Compositum	Glycerin, 100 Alcohol, 500 Water, 400	Dil. Alcohol	850	750 Gm. Sarsaparilla; 120 Gm. Glycyrrhiza; 100 Gm. Sassafras; 30 Gm. Mezereum
Taraxaci	Glycerin, 100 Alcohol, 500 Water, 400	Dil. Alcohol	850	
Lobeliæ	Acetic Acid, 50 Alcohol, 500 Water, 450	Dil. Alcohol	850	
Ergotæ	Hydrochloric Acid, 20 Dil. Alc., 980	Dil. Alcohol	850	
Ipecacuanhæ	Dil. HCl, 100 Alcohol, 200 Water, 200	Alcohol, 2 Water, 3	800	Menstruum I consists of only 500 mils instead of the usual 1000 mils. Fluidextract of Ipecac is assayed. 100 mils contains from 1.8 to 2.2 Gm. of ether-soluble alkaloids of Ipecac
Uvæ Ursi	Glycerin, 100 Alcohol, 300 Water, 500	Alcohol, 1 Water, 2	800	

Made by "**Type Process C**" (used for fluidextracts which contain valuable, volatile constituents or other active principles which would be injured by even moderate heat. But it may be used to advantage for any fluidextract directed to be made by Type Process A). The 1000 Gm. of drug is divided into three portions of 500, 300, and 200 Gm., respectively. The 500 Gm. portion is first percolated, in the usual way, the first 200 mils of percolate being reserved and the subsequent 1500 mils of percolate collected in portions of 300 mils each. The 300 Gm. portion of drug is now percolated, using as menstruum the 1500 mils of weak percolate from the 500 Gm. of drug, in the order of their strength, the most concentrated first. Reserve the first 300 mils of percolate from the 300 Gm. of drug and collect 800 mils additional percolate in 200-mil portions. Now percolate the 200-Gm. lot of drug, using the 800 mils of weak percolate as menstruum and more of the original menstruum, if necessary, until the percolate measures 500 mils. Mix this with the reserved portions to make 1000 mils of finished fluidextract. If the fluidextract is to be assayed, collect only 450 mils of percolate from the last portion of drug, assay the mixed reserves and adjust the final volume to conform to the required alkaloidal standard:

Title	Menstruum	Remarks
Fluidextractum Aromaticum	Alcohol	350 Gm. Saigon Cinnamon; 350 Gm. Jamaica Ginger; 150 Gm. Cardamom Seed; 150 Gm. Myristica
Aconiti	Alcohol, 3 Water, 1	Assayed, 100 mils contains from 0.45 to 0.55 Gm. of the ether-soluble alkaloids of Aconite. A biological assay optional
Aurantii Amari	Alcohol, 3 Water, 1	

U.S.P. IX Fluidextracts—*Continued*

Made by "Type Process D" (used for fluidextracts of drugs which contain active constituents wholly soluble in water). Add 500 mils of boiling Water to 1000 Gm. of the ground drug, digest for two hours, transfer to a metallic percolator and add boiling water until the drug is exhausted. Evaporate the percolate on a water bath to the specified volume, add the Alcohol when cold, mix and filter.

Title	Evaporate to the following volume in mils	Add Alcohol in mils	Remarks
Fluidextractum Cascaræ Sagradæ	750	250	
Cascaræ Sagradæ Aromaticum	500	250	Special process (see page 541). The following other ingredients are used: 125 Gm. Magnesium Oxide; 40 Gm. Pure Extract of Glycyrrhiza; 200 mils Glycerin; 1 Gm. Benzosulphinide; 2.5 mils Oil of Anise; 0.2 mil Oil of Cinnamon; 0.1 mil Oil of Coriander; 0.2 mil Methyl Salicylate
Frangulæ	750	250	
Tritici	800	200	

Special Process

Title	Method of Preparation
Fluidextractum Glycyrrhizæ	Moisten the 1000 Gm. of drug with a sufficient quantity of a mixture of 3 volumes of Ammonia Water and 27 volumes of Chloroform Water and, after 48 hours' maceration, percolate to exhaustion with this menstruum. Reserve the first 500 mils of percolate, evaporate the remainder to a soft extract, dissolve the extract in the reserve and add enough water to make 750 mils. Use a few drops of Ammonia Water if necessary to facilitate solution. Then gradually add 250 mils of Alcohol, decant the clear liquid after standing seven days, filter the remainder and add enough of a mixture of 1 volume of Alcohol and 3 volumes of Water to make 1000 mils

N. F. IV Fluidextracts arranged in classes according to the Method of Preparation and Alcoholic Strength

Prepare by "**Type Process A**" (see page 521)

Title	Menstruum	Mils of Reserve	Remarks
	Alcohol		
Fluidextractum Angelicæ Radicis	"	850	
Apii Fructus	"	850	Remove any separated oil by filtering through an alcohol-wetted filter
Boldi	"	850	
Calendulæ	"	850	
Cubebæ	"	850	
Gossypii Corticis	"	800	
Iridis Versicoloris	"	850	
Jalapæ	"	850	Mix the ground drug with 1500 Gm. of clean sand before percolation
Lupulini	"	850	
Thujæ	"	850	
	Alcohol, 9 **Water, 1**		
Fluidextractum Paracoto	" "	850	
	Alcohol, 4 **Water, 1**		
Fluidextractum Dioscoreæ	" "	850	
Echinaceæ	" "	850	
Euonymi	" "	800	
Mezerei	" "	850	
Serpentariæ	" "	850	
Valerianæ	" "	850	
	Alcohol, 3 **Water, 1**		
Fluidextractum Adonidis	" "	850	
Baptisiæ	" "	850	
Caulophylli	" "	850	
Chionanthi	" "	850	
Cocillanæ	" "	850	
Convallariæ Radicis	" "	850	
Corydalis	" "	850	
Damianæ	" "	850	
Fuci	" "	850	
Matico	" "	850	
Trillii	" "	850	
	Alcohol, 2 **Water, 1**		
Fluidextractum Araliæ	" "	850	
Buchu Compositum	" "	850	625 Gm. Buchu; 125 Gm. Cubeb; 125 Gm. Juniper Berries; 125 Gm. Uva Ursi
Colchici Cormi	" "	850	Assayed, 100 mils contains from 0.31 to 0.39 Gm. of Colchicine
Convallariæ Florum	" "	850	
Droseræ	" "	850	
Kolæ	" "	850	
Petroselini Radicis	" "	850	
Senecionis	" "	850	
Solani	" "	850	
Stramonii	" "	850	Assayed, 100 mils contains from 0.22 to 0.28 Gm. Stramonium alkaloids
Viburni Opuli	" "	850	
	Alcohol, 5 **Water, 3**		
Fluidextractum Humuli	" "	800	
	Alcohol, 3 **Water, 2**		
Fluidextractum Hydrangeæ	" "	850	
Kavæ	" "	850	
	Diluted Alcohol		
Fluidextractum Aletridis	" "	850	
Arnicæ	" "	850	
Asclepiadis	" "	850	
Berberidis	" "	850	
Chimaphilæ	" "	850	
Chiratæ	" "	850	
Condurango	" "	850	

N. F. IV Fluidextracts—*Continued*

Title	Menstruum	Mils of Reserve	Remarks
Fluidextractum	**Diluted Alcohol**		
Coptis	" "	850	
Cypripedii	" "	850	
Dulcamaræ	" "	850	
Eupatorii	" "	800	
Euphorbiæ Piluliferæ	" "	850	
Galegæ	" "	850	
Helianthemi	" "	850	
Heloniatis	" "	850	
Juniperi	" "	850	
Lappæ	" "	800	
Leptandræ	" "	850	
Pareiræ	" "	850	
Phytolaccæ	" "	800	
Rhamni Catharticæ	" "	750	
Rubi	" "	800	
Rumicis	" "	850	
Scoparii	" "	750	
Scutellariæ	" "	800	
Trifolii	" "	800	
Verbasci Foliæ	" "	850	
Verbenæ	" "	850	
Zeæ	" "	850	
	Alcohol, 3 **Water, 4**		
Fluidextractum Cataríæ	" "	850	
	Alcohol, 1 **Water, 2**		
Fluidextractum Quassiæ	" "	850	

Prepared by "Type Process B" (see page 521)

Title	Menstruum I mils	Menstruum II	Mils of Reserve	Remarks
Fluidextractum Calumbæ	Glycerin, 100 Alcohol, 800 Water, 100	Alcohol, 4 Water, 1	850	
Sanguinariæ	100 Gm. Citric Acid; Water to make 250 Alcohol, 750	Alcohol, 3 Water, 1	850	
Apocyni	Glycerin, 100 Alcohol, 600 Water, 300	Alcohol, 3 Water, 2	850	
Geranii	Glycerin, 100 Alcohol, 600 Water, 300	Alcohol, 3 Water, 2	800	
Stillingiæ Compositum	Glycerin, 250 Alcohol, 500 Water, 250	Dil. Alcohol	850	250 Gm. Stillingia; 250 Gm. Corydalis; 125 Gm. Blue Flag; 125 Gm. Sambucus; 125 Gm. Chimaphila; 63 Gm. Coriander; 62 Gm. Prickly Ash Berries
Juglandis	Glycerin, 100 Alcohol, 500 Water, 400	Dil. Alcohol	850	
Krameriæ	Glycerin, 100 Alcohol, 500 Water, 400	Dil. Alcohol	800	
Quercus	Glycerin, 100 Alcohol, 500 Water, 400	Dil. Alcohol	700	
Rhois Glabræ	Glycerin, 100 Alcohol, 500 Water, 400	Dil. Alcohol	850	
Corni	Glycerin, 150 Dil. Alc., 850	Dil. Alcohol	850	
Hamamelidis Foliorum	Glycerin, 100 Alcohol, 300 Water, 500	Alcohol, 1 Water, 2	850	
Thymi	Glycerin, 100 Alcohol, 250 Water, 650	Alcohol, 1 Water, 3	850	
Coffeæ	Glycerin, 65 Alcohol, 250 Water, 685	Alcohol, 1 Water, 3	850	

N. F. IV Fluidextracts—*Continued*

Prepared by "Type Process C" (see page 524)

Title	Menstruum I	Menstruum II	Remarks
Fluidextractum Conii	Acetic Acid, 20 Dil. Alcohol, 980	Dil. Alcohol	Assayed, 100 mils contains from 0.35 to 0.45 Gm. of Coniine

Special Processes

Title	Method of Preparation
Fluidextractum Castaneæ	Macerate the 1000 Gm. of drug with 5000 mils of boiling water during 2 hours, strain with pressure, pack the residue in a percolator and exhaust with cold water. Evaporate the combined liquids, on a water bath, to 2000 mils, cool, add 600 mils of Alcohol, allow it to clear by subsidence, filter, evaporate the clear liquid to 700 mils, and, when cold, add 100 mils of Glycerin and enough Alcohol to make 1000 mils
Cinchonæ Aquosum	Assayed, 100 mils contains from 4.5 to 5.5 Gm. of Cinchona alkaloids. Mix 30 mils of Hydrochloric Acid with 125 mils of Glycerin and 5000 mils of Water, moisten 1000 Gm. of Red Cinchona with 350 mils of the mixture, pack it in a percolator, macerate for 48 hours, and then percolate to exhaustion, using first the menstruum prepared and then Water. Reserve the first 700 mils of percolate, evaporate the remainder to 400 mils, at a temperature not exceeding 80° C. (176° F.), add the reserve portion and evaporate to 700 mils. Assay a portion and add enough Alcohol and Water to the remaining portion to make the finished Fluidextract contain 12 per cent., by volume, of absolute alcohol and the amount of alkaloids required
Pruni Virginianæ	Moisten 1000 Gm. of the ground drug with a mixture of 200 mils of Glycerin and 400 mils of Water, pack loosely in a percolator and macerate for 24 hours. Then add a mixture of 250 mils of Alcohol and 150 mils of Water and again macerate for 24 hours. Now percolate slowly with a mixture of 1 volume of Alcohol and 3 volumes of Water until exhausted. Reserve the first 850 mils of percolate, evaporate the remainder to a soft extract, dissolve this in the reserve and add enough of the alcoholic mixture to make 1000 mils

Table of Unofficial Fluidextracts and Liquid Extracts

(To make 1000 mils)

Name	Number of mils used to moisten	Menstruum	Number of mils Reserved	Fineness of Powder	Process and Remarks
Extractum Arnicæ Radicis Fluidum. U. S. P. 1890	400	Alc. 75; Wat. 25	900	60	General process (see below)
Belæ Liquidum. Br.	...	Chloroform Water	...	Bruised	Macerate the 1000 Gm. of bruised Bael Fruit for 12 hours in 5000 mils of Chloroform Water. Pour off the liquid and repeat the maceration twice, an hour each time, using 5000 mils of Chloroform Water for each maceration. Evaporate the mixed liquid to 750 mils and add 250 mils of Alcohol
Cusso Fluidum. U. S. P. 1890	400	Alcohol	900	40	General process (see below)
Menispermi Fluidum, U. S. P. 1890	400	Alc. 60; Wat. 30	900	60	" " " "
Opii Liquidum. Br.	...	.....	...	...	37.5 Gm. Dry Extract of Opium; 200 mils 90 per cent. Alcohol; Distilled Water, enough to make 1000 mils. Rub the extract with 700 mils of the water, stir frequently during 24 hours, add the Alcohol, set aside for twenty-four hours, filter, and add enough Distilled Water to make 1000 mils
Picrorhizæ Liquidum. Br.	...	Alcohol, 60 per cent.	850	60	General process (see below)

General Process for Fluidextracts.—Having moistened the powder, macerate for forty-eight hours, then exhaust with the menstruum, reserving the number of mils directed and distilling or evaporating the remainder to a soft extract; add this to the reserved portion and sufficient menstruum to make the finished fluidextracts measure 1000 mils.

FLUIDEXTRACTUM ACONITI. U. S. **Fluidextract of Aconite**
[Fldext. Aconit. FLUID EXTRACT OF ACONITE]

One hundred mils of Fluidextract of Aconite yields not less than 0.45 Gm. nor more than 0.55 Gm. of the ether-soluble alkaloids of aconite. If assayed biologically the minimum lethal dose should not be greater than 0.00004 mil for each gramme of body weight of guinea-pig.

	Metric	Old form
***Aconite**, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	3 pints

Divide the powdered drug into three portions of 500 Gm. [old form 25 oz. av.], 300 Gm. [old form 15 oz. av.] and 200 Gm. [old form 10 oz. av.], respectively. Moisten the first portion of the drug (500 Gm., or old form 25 oz. av.) with a sufficient quantity of a menstruum, prepared by mixing 3 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours and then allow the percolation to proceed slowly, gradually adding more of the menstruum. Reserve the first 200 mils [old form 9 fl. oz. 288 min.] of percolate and continue the process until the additional percolate measures 1500 mils [old form 4½ pints], the latter being collected in successive portions of 300 mils [old form about 14½ fl. oz.] each.

Moisten the second portion of the powdered drug (300 Gm., or old form 15 oz. av.) with a sufficient quantity of the percolate collected in the preceding operation, immediately after the reserved portion, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and macerate and percolate as directed for the first part of the drug, using as a menstruum the several portions of percolate from the preceding operation in the order in which they have been collected, and, if this be insufficient, follow with some of the original menstruum. Reserve the first 300 mils [old form 14 fl. oz. 192 min.] of percolate and continue the process until the additional percolate measures 800 mils [old form 38½ fl. oz.], collecting the weaker percolate in successive portions of 200 mils [old form about 9½ fl. oz.] each.

Moisten the third portion of the powdered drug (200 Gm., or old form 10 oz. av.) with a sufficient quantity of the percolate collected in the preceding operation, immediately after the reserved portion, to render it evenly and distinctly damp and to maintain it so after macerating it for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and macerate and percolate as before, using as menstruum the several portions of percolate from the preceding operation in the order in which they have been collected, and, if this be insufficient, follow with more of the original menstruum. Collect 400 mils [old form about 19 fl. oz.] of percolate from the third portion of the drug and mix this percolate with the two portions previously

reserved. Assay a portion of the mixture and then adjust its volume, by the addition of the menstruum directed, so that each 100 mils of finished Fluidextract contains 0.5 Gm. of the ether-soluble alkaloids of aconite. (U. S. P. Type Process C.)

Assay.—From a pipette drop 15 mils of Fluidextract of Aconite evenly over the surface of 15 Gm. of purified sawdust (see Reagents, Chapter LXII) and evaporate to dryness at a temperature not exceeding 75° C. (167° F.). Transfer the mixture to a 250-mil flask, add 150 mils of ether, and proceed as directed under *Belladonnæ Radix*, third line of the Assay, modifying the process there given by using the ammonia water with a small quantity of distilled water to rinse the dish in which the mixture was evaporated, and ether only in the final shaking out of the alkaloids.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 64.539 milligrammes of the ether-soluble alkaloids of aconite.

For an alternative method of assaying Fluidextract of Aconite see Biological Assays (Chapter LXII).

Type Process C is adopted here to avoid the use of heat which would rapidly change the Aconitine to inert decomposition products. Any such change, if it occurred, would not be detected by the chemical assay but would be shown by the biological test on the guinea-pig.

N. F. Preparation.—Linimentum Aconiti et Chloroformi.

Average dose.—½ minim (0.03 mil).

FLUIDEXTRACTUM AROMATICUM. U. S. **Aromatic Fluidextract**

[Fldext. Aromat. AROMATIC FLUID EXTRACT]

	Metric	Old form
***Aromatic Powder**	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Divide the powdered drug into three portions of 500 Gm. [old form 25 oz. av.], 300 Gm. [old form 15 oz. av.] and 200 Gm. [old form 10 oz. av.], respectively. Moisten the first portion of the drug (500 Gm., or old form 25 oz. av.) with a sufficient quantity of alcohol to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours and then allow the percolation to proceed slowly, gradually adding more of the menstruum. Reserve the first 200 mils [old form 9 fl. oz. 288 min.] of percolate and continue the process until the additional percolate measures 1500 mils [old form 4½ pints], the latter being collected in successive portions of 300 mils [old form about 14½ fl. oz.] each.

Moisten the second portion of the powdered drug (300 Gm., or old form 15 oz. av.) with a sufficient quantity of the percolate collected in the preceding operation, immediately after the reserved portion, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and macerate and percolate as directed for the first part of the drug, using as a menstruum the several portions of percolate from the preceding operation in the order in which they have been collected, and, if this be insufficient, follow with some of the original menstruum. Reserve the first 300 mils [old form 14 fl. oz. 192 min.]

of percolate and continue the process until the additional percolate measures 800 mils [old form about 38½ fl. oz.], collecting the weaker percolate in successive portions of 200 mils [old form about 9½ fl. oz.] each.

Moisten the third portion of the powdered drug (200 Gm., or old form 10 oz. av.) with a sufficient quantity of the percolate collected in the preceding operation, immediately after the reserved portion, to render it evenly and distinctly damp and to maintain it so after macerating it for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and macerate and percolate as before, using as menstruum the several portions of percolate from the preceding operation in the order in which they have been collected, and, if this be insufficient, follow with more of the original menstruum. Collect 500 mils [old form 1½ pints] of percolate and mix this with the two portions previously reserved so as to make 1000 mils [old form 3 pints] of finished Fluidextract. (U. S. P. Type Process C.)

Type Process C has been adopted here to avoid the use of heat which would volatilize some of the oils from the aromatic drugs.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM ASPIDOSPERMATIS. U. S. **Fluidextract of Aspidosperma**

[**Fldext. Aspidosp.** Fluidextract of Aspidosperma Fluidextract of Quebracho]

	Metric	Old form
***Aspidosperma**, in No. 30 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 110 mils [old form 5 fl. oz. 135 minims] of glycerin, 670 mils [old form 32 fl. oz. 76 minims] of alcohol and 220 mils [old form 10 fl. oz. 269 minims] of water, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator, add the remainder of the menstruum prepared, and, when this has just disappeared from the surface, gradually add a mixture of 2 volumes of alcohol and 1 volume of water, constantly maintaining a stratum of liquid above the drug. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours, and then allow the percolation to proceed slowly, gradually adding more of the second menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate, recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the second menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process B.)

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM AURANTII AMARI. U. S. **Fluidextract of Bitter Orange Peel**

[**Fldext. Aurant. Amar.** FLUIDEXTRACT OF BITTER ORANGE PEEL]

	Metric	Old form
***Bitter Orange Peel,** in No. 20 powder.....	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make.....	**1000 mils**	3 pints

Divide the powdered drug into three portions of 500 Gm. [old form 25 oz. av.], 300 Gm. [old form 15 oz. av.] and 200 Gm. [old form 10 oz. av.], respectively. Moisten the first portion of the drug (500 Gm., or old form 25 oz. av.) with a sufficient quantity of a menstruum, prepared by mixing 3 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours and then allow the percolation to proceed slowly, gradually adding more of the menstruum. Reserve the first 200 mils [old form about 9½ fl. oz.] of percolate and continue the process until the additional percolate measures 1500 mils [old form 4½ pints], the latter being collected in successive portions of 300 mils [old form about 14½ fl. oz.] each.

Moisten the second portion of the powdered drug (300 Gm., or old form 15 oz. av.) with a sufficient quantity of the percolate collected in the preceding operation, immediately after the reserved portion, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and macerate and percolate as directed for the first part of the drug, using as a menstruum the several portions of percolate from the preceding operation in the order in which they have been collected, and, if this be insufficient, follow with some of the original menstruum. Reserve the first 300 mils [old form about 14½ fl. oz.] of percolate and continue the process until the additional percolate measures 800 mils [old form about 38½ fl. oz.], collecting the weaker percolate in successive portions of 200 mils [old form about 9½ fl. oz.] each.

Moisten the third portion of the powdered drug (200 Gm., or old form 10 oz. av.) with a sufficient quantity of the percolate collected in the preceding operation, immediately after the reserved portion, to render it evenly and distinctly damp and to maintain it so after macerating it for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and macerate and percolate as before, using as menstruum the several portions of percolate from the preceding operation in the order in which they have been collected, and, if this be insufficient, follow with more of the original menstruum. Collect 500 mils [old form 1½ pints] of percolate and mix this with the two portions previously reserved so as to make 1000 mils [old form 3 pints] of finished Fluidextract. (U. S. P. Type Process C.)

N. F. Preparation.—Vinum Rhei Compositum.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM BELLADONNÆ RADICIS. U. S. Fluidextract of Belladonna Root

[Fldext. Bellad. Rad. FLUIDEXTRACT OF BELLADONNA ROOT]

One hundred mils of Fluidextract of Belladonna Root yields not less than 0.405 Gm. nor more than 0.495 Gm. of the alkaloids of belladonna root.

	Metric	Old form
***Belladonna Root**, in No. 40 powder.....	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make about.....	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 5 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 800 mils [old form 38½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly and assay a portion as directed below, and, from the result thus obtained, ascertain by calculation the amount of alkaloids in the remainder of the liquid and dilute this with enough menstruum to make each 100 mils of the finished Fluidextract contain 0.45 Gm. of the alkaloids of belladonna root. (U. S. P. Type Process A.)

Assay.—Introduce 10 mils of Fluidextract of Belladonna Root into a separator and add 10 mils of distilled water and 2 mils of ammonia water. Completely extract the alkaloids by shaking out repeatedly with chloroform and then extract the alkaloids from the chloroform solution by shaking out repeatedly with weak sulphuric acid until the alkaloids are completely removed. Collect the acid washings in a separator, add ammonia water until the solution is decidedly alkaline to litmus, and completely extract the alkaloids by shaking out repeatedly with chloroform. Evaporate the combined chloroform washings to dryness, dissolve the alkaloids from the residue in exactly 5 mils of tenth-normal sulphuric acid V.S. and titrate the excess of acid with fiftieth-normal potassium hydroxide V.S., using cochineal T.S. as indicator.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 28.92 milligrammes of the alkaloids of belladonna root (see Proximate Assays, Chapter LXII).

U. S. P. Preparation.—Linimentum Belladonnæ.

Average dose.—1 minim (0.05 mil).

FLUIDEXTRACTUM BUCHU. U. S. Fluidextract of Buchu

[Fldext. Buchu FLUIDEXTRACT OF BUCHU]

	Metric	Old form
***Buchu**, in No. 40 powder.....	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make.....	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of alcohol to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a

cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

N. F. Preparation.—Elixir Buchu.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM CANNABIS. U. S. Fluidextract of Cannabis

[Fldext. Cannab. Fluidextractum Cannabis Indicæ, U. S. P. VIII Fluidextract of Cannabis]

When assayed biologically Fluidextract of Cannabis produces incoordination when administered to dogs in a dose of not more than 0.03 mil per kilogramme of body weight.

	Metric	Old form
***Cannabis,** in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make about	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of alcohol to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, assay a portion as directed below and from the result thus obtained adjust the volume of the finished Fluidextract to conform to the above biological standard. (U. S. P. Type Process A.)

Assay.—Proceed as directed under Biological Assays (Chapter LXII).

N. F. Preparation.—Collodium Salicylici Compositum.

Average dose.—1½ minims (0.1 mil).

FLUIDEXTRACTUM CASCARÆ SAGRADÆ. U. S. Fluidextract of Cascara Sagrada

[Fldext. Casc. Sagr. Fluidextractum Rhamni Purshianæ, U. S. P. VIII Fluidextract of Cascara Sagrada]

	Metric	Old form
***Cascara Sagrada,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol	**250 mils**	12 fl. oz.
Water, a sufficient quantity,		
To make	**1000 mils**	3 pints

Add 500 mils [old form 1½ pints] of boiling water to the ground drug, mix thoroughly and allow it to macerate in a covered container for two hours in a warm place. Then transfer the moist drug to a tinned or enameled metallic percolator and allow percolation to proceed, gradually adding boiling water until the drug is exhausted. Evaporate the percolate on a water bath or steam bath to 750 mils [old form 36 fl. oz.] and when cold gradually add the alcohol and, if necessary, sufficient water to make the product measure 1000 mils [old form 3 pints] and mix thoroughly. (U. S. P. Type Process D.)

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM CASCARÆ SAGRADÆ AROMATICUM. U. S. Aromatic Fluidextract of Cascara Sagrada

[**Fldext. Casc. Sagr. Arom.** Fluidextractum Rhamni Purshianæ Aromaticum, U. S. P. VIII Aromatic Fluidextract of Cascara Sagrada]

	Metric	Old form
***Cascara Sagrada,** in No. 40 powder	**1000.0 Gm.**	50 oz. av.
Magnesium Oxide	**125.0 Gm.**	6 oz. av. 114 gr.
Pure Extract of Glycyrrhiza	**40.0 Gm.**	2 oz. av.
Glycerin	**200.0 mils**	9 fl. oz. 288 min.
Alcohol	**250.0 mils**	12 fl. oz.
Benzosulphinide	**1.0 Gm.**	22 gr.
Oil of Anise	**2.5 mils**	57 min.
Oil of Cinnamon	**0.2 mil**	4½ min.
Oil of Coriander	**0.1 mil**	2 min.
Methyl Salicylate	**0.2 mil**	4½ min.
Boiling Water, a sufficient quantity,		
To make	**1000 mils**	3 pints

Thoroughly mix the cascara sagrada with the magnesium oxide, moisten the mixture with 2000 mils [old form 6 pints] of boiling water, set it aside for two hours, stirring occasionally, and then pack it in a percolator. Now pour on boiling water and allow the percolate to proceed until the drug is exhausted. Evaporate the percolate to 500 mils [old form 1½ pints] and while yet warm dissolve in it the extract of glycyrrhiza. When cold, add the glycerin, then the alcohol in which the benzosulphinide and the oils have been dissolved, and finally sufficient water to make the Fluidextract measure 1000 mils [old form 3 pints].

The preliminary treatment of the drug with an alkali (magnesium carbonate) is for the purpose of neutralizing the acid resins present in cascara sagrada to which the bitterness is due. When these are neutralized the drug becomes practically bitterless. Lime is often used instead of magnesium carbonate.

N. F. Preparations.—Elixir Cascaræ Sagradæ; Elixir Cascaræ Sagradæ Compositum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM CIMICIFUGÆ. U. S. Fluidextract of Cimicifuga

[**Fldext. Cimicif.** Fluidextract of Cimicifuga Fluidextract of Black Cohosh Fluidextract of Black Snakeroot]

	Metric	Old form
***Cimicifuga,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of alcohol to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

N. F. Preparations.—Elixir Sodii Salicylatis Compositum; Syrupus Cimicifugæ Compositus.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM CINCHONÆ. U. S. **Fluidextract of Cinchona**

[Fldext. Cinchon. Fluidextract of Cinchona Fluidextract of Calisaya Bark]

One hundred mils of Fluidextract of Cinchona yields not less than 4 Gm. nor more than 5 Gm. of the alkaloids of cinchona.

	Metric	Old form
***Cinchona,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Diluted Hydrochloric Acid,		
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 100 mils [old form 4 fl. oz. 384 minims] of glycerin, 100 mils [old form 4 fl. oz. 384 minims] of diluted hydrochloric acid and 800 mils [old form 38 fl. oz. 192 minims] of alcohol, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator, add the remainder of the menstruum prepared, and, when this has just disappeared from the surface, gradually add a menstruum, prepared by mixing 4 volumes of alcohol and 1 volume of water, constantly maintaining a stratum of liquid above the drug. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours, and then allow the percolation to proceed slowly, gradually adding more of the second menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate, recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and assay a portion as directed below, and, from the result thus obtained, ascertain by calculation the

amount of alkaloids in the remainder of the liquid, and dilute this with enough of the second menstruum to make each 100 mils of the finished Fluidextract contain 4.5 Gm. of the total alkaloids of cinchona. (U. S. P. Type Process B.)

Assay.—From a pipette drop 5 mils of Fluidextract of Cinchona evenly over the surface of 10 Gm. of purified sawdust (see Reagents, Chapter LXII) and evaporate it to dryness at a temperature not exceeding 80° C. (176° F.). Transfer the mixture to a 500-mil flask, and proceed as directed under *Cinchona*, second line of the Assay, modifying the process there given by increasing the amount of ammonia water to 10 mils, using this in divided portions to rinse the dish in which the mixture was evaporated, and adding the rinsings to the flask.

The weight of the residue is the amount of total alkaloids from 4 mils of Fluidextract of Cinchona.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM COLCHICI SEMINIS. U. S. Fluidextract of Colchicum Seed

[Fldext. Colch. Sem. Fluidextract of Colchicum Seed]

One hundred mils of Fluidextract of Colchicum Seed yields not less than 0.36 Gm. nor more than 0.44 Gm. of colchicine.

	Metric	Old form
***Colchicum Seed**, in No. 40 powder	**1000 Gm.**	**50 oz. av.**
Purified Petroleum Benzin,		
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	**3 pints**

Pack the colchicum seed in a cylindrical percolator and slowly percolate with purified petroleum benzin until a few drops of the percolate leave no greasy stain when evaporated on a piece of filter paper. Reject the benzin solution, remove the powder from the percolator and dry it by exposure to the air.

Moisten this dried drug with a sufficient quantity of a menstruum, prepared by mixing 2 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, assay a portion as directed below, and, from the result thus obtained, ascertain by calculation the amount of alkaloids in the remainder of the liquid, and dilute this with enough menstruum to make each 100 mils of the finished Fluidextract contain 0.4 Gm. of colchicine. (U. S. P. Type Process A.)

Assay.—Introduce 15 mils of Fluidextract of Colchicum Seed into a 500-mil flask, add 10 mils of solution of lead subacetate, previously diluted with 35 mils of distilled water, shake the mixture thoroughly, then add 240 mils of distilled water, again agitate the mixture and proceed as directed under *Colchici Semen*, fifth line of the Assay.

N. F. Preparation.—Vinum Colchici Seminis.

Average dose.—3 minims (0.2 mil).

FLUIDEXTRACTUM DIGITALIS. U. S. Fluidextract of Digitalis

[Fldext. Digital. FLUIDEXTRACT OF DIGITALIS]

If assayed biologically the minimum lethal dose should not be greater than 0.0006 mil of the Fluidextract, or the equivalent in Fluidextract of 0.0000005 Gm. of ouabain, for each gramme of body weight of frog.

	Metric	Old form
***Digitalis,** in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 5 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

Assay.—For a method of assaying Fluidextract of Digitalis see Biological Assays (Chapter LXII).

Average dose.—1 minim (0.05 mil).

FLUIDEXTRACTUM ERGOTÆ. U. S. Fluidextract of Ergot

[Fldext. Ergot. FLUIDEXTRACT OF ERGOT SECALIS CORNUTI EXTRACTUM FLUIDUM, P. I.]

	Metric	Old form
***Ergot,** recently ground and in No. 40 powder	**1000 Gm.**	50 oz. av.
Hydrochloric Acid,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 20 mils [old form 460 minims] of hydrochloric acid and 980 mils [old form 47 fl. oz. 20 minims] of diluted alcohol, to render it evenly and distinctly damp and to maintain it so

after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator, add the remainder of the menstruum prepared, and, when this has just disappeared from the surface, gradually add diluted alcohol, constantly maintaining a stratum of liquid above the drug. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours, and then allow the percolation to proceed slowly, gradually adding more of the second menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate, recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the second menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process B.)

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM ERIODICTYI. U. S. **Fluidextract of Eriodictyon**

[**Fldext. Eriodict.** Fluidextract of Eriodictyon Fluidextract of Yerba Santa]

	Metric	Old form
***Eriodictyon,** in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 4 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 800 mils [old form 38½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

N. F. Preparations.—Elixir Eriodictyi Aromaticum; Syrupus Eriodictyi Aromaticus.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM EUCALYPTI. U. S. **Fluidextract of Eucalyptus**

[**Fldext. Eucalypt.** Fluidextract of Eucalyptus]

	Metric	Old form
***Eucalyptus,** in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 3 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 800 mils [old form 38½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM FRANGULÆ. U. S. **Fluidextract of Frangula**

[Fldext. Frangul. FLUIDEXTRACT OF FRANGULA FLUIDEXTRACT OF BUCKTHORN BARK]

	Metric	Old form
***Frangula,** in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol	**250 mils**	12 fl. oz.
Water, a sufficient quantity,		
To make	**1000 mils**	3 pints

Add 500 mils of boiling water to the ground drug, mix thoroughly and allow it to macerate in a covered container for two hours in a warm place. Then transfer the moist drug to a tinned or enameled metallic percolator and allow percolation to proceed, gradually adding boiling water until the drug is exhausted. Evaporate the percolate on a water bath or steam bath to 750 mils [old form 36 fl. oz.] and when cold add the alcohol and, if necessary, sufficient water to make the product measure 1000 mils [old form 3 pints], and mix thoroughly. (U. S. P. Type Process D.)

N. F. Preparations.—Elixir Catharticum Compositum; Syrupus Sennæ Compositus.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM GELSEMII. U. S. **Fluidextract of Gelsemium**

[Fldext. Gelsem. FLUIDEXTRACT OF GELSEMIUM]

	Metric	Old form
***Gelsemium,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 4 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so

after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

N. F. Preparation.—Elixir Sodii Salicylatis Compositum.

Average dose.—½ minim (0.03 mil).

FLUIDEXTRACTUM GENTIANÆ. U. S. **Fluidextract of Gentian**

[Fldext. Gentian. FLUIDEXTRACT OF GENTIAN]

	Metric	Old form
***Gentian,** in No. 30 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of diluted alcohol to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

N. F. Preparations.—Elixir Gentianæ; Elixir Gentianæ et Ferri; Elixir Gentianæ et Ferri Phosphatis; Elixir Gentianæ Glycerinatum.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM GLYCYRRHIZÆ. U. S. **Fluidextract of Glycyrrhiza**

[Fldext. Glycyrrh. FLUIDEXTRACT OF GLYCYRRHIZA FLUIDEXTRACT OF LICORICE]

	Metric	Old form
***Glycyrrhiza,** in No. 20 powder	**1000 Gm.**	50 oz. av.
Alcohol	**250 mils**	12 fl. oz.
Ammonia Water,		
Chloroform Water,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Mix 300 mils [old form about 14½ fl. oz.] of ammonia water with 2700 mils [old form about 8 pints 1½ fl. oz.] of chloroform water and moisten the glycyrrhiza with a sufficient quantity of the mixture; pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more of the same menstruum until the glycyrrhiza is exhausted. Reserve the first 500 mils [old form 1½ pints] of the percolate and evaporate the remainder on a water bath to a soft extract; dissolve this in the reserve portion and add enough water to make the product measure 750 mils [old form 36 fl. oz.]. A few drops of ammonia water may be added if necessary to facilitate solution. Now gradually add the alcohol, allow the product to stand for seven days in a stoppered container, then decant the clear liquid, filter the remainder and wash the residue on the filter with enough of a mixture of 1 volume of alcohol and 3 volumes of water to make the Fluidextract measure 1000 mils [old form 3 pints].

U. S. P. Preparations.—Elixir Glycyrrhizæ; Syrupus Sarsaparillæ Compositus.

N. F. Preparations.—Elixir Glycyrrhizæ Aquosum; Elixir Glycyrrhizæ Aromaticum; Elixir Taraxaci Compositum; Syrupus Cimicifugæ Compositus.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM GRANATI. U. S. Fluidextract of Pomegranate

[Fldext. Granat. Fluidextract of Pomegranate]

	Metric	Old form
***Pomegranate**, in No. 30 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 100 mils [old form 4 fl. oz. 384 minims] of glycerin, 500 mils [old form 1½ pints] of alcohol and 400 mils [old form 19 fl. oz. 96 minims] of water, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator, add the remainder of the menstruum prepared, and when this has just disappeared from the surface, gradually add diluted alcohol, constantly maintaining a stratum of liquid above the drug. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours, and then allow the percolation to proceed slowly, gradually adding more of the second menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate, recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the second menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process B.)

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM GRINDELIÆ. U. S. **Fluidextract of Grindelia**
[Fldext. Grindel. FLUIDEXTRACT OF GRINDELIA]

	Metric	Old form
***Grindelia,** in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 3 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM GUARANÆ. U. S. **Fluidextract of Guarana**
[Fldext. Guaran. FLUIDEXTRACT OF GUARANA]

One hundred mils of Fluidextract of Guarana yields not less than 3.6 Gm. nor more than 4.4 Gm. of caffeine.

	Metric	Old form
***Guarana,** in No. 60 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 3 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 800 mils [old form 38½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, assay a portion as directed below, and, from the

result thus obtained, ascertain by calculation the amount of alkaloid in the remainder of the liquid and dilute this with enough menstruum to make each 100 mils of the finished Fluidextract contain 4 Gm. of caffeine. (U. S. P. Type Process A.)

Assay.—Introduce 5 mils of Fluidextract of Guarana into a separator, add 1 mil of ammonia water, and shake out the alkaloid with chloroform until completely extracted as shown by testing with iodine T.S. Evaporate the combined chloroform solutions to dryness and dissolve the residue in 20 mils of distilled water with the aid of heat. Allow this to cool, filter it into a separator and wash the container and filter with several small portions of distilled water, adding the rinsings to the liquid in the separator. Then shake out the alkaloid with chloroform until completely extracted, as shown by testing with iodine T.S., evaporate the combined chloroform solutions and dry the residue to constant weight at 80° C. (176° F.). The weight represents the alkaloid in 5 mils of Fluidextract of Guarana (see Proximate Assays, Chapter LXII).

N. F. Preparation.—Elixir Guaranæ.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM HYDRASTIS. U. S. **Fluidextract of Hydrastis** [**Fldext. Hydrast.** Fluidextract of Hydrastis Fluidextract of Golden Seal]

One hundred mils of Fluidextract of Hydrastis yields not less than 1.8 Gm. nor more than 2.2 Gm. of the ether-soluble alkaloids of hydrastis.

	Metric	Old form
***Hydrastis**, in No. 40 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 100 mils [old form 4 fl. oz. 384 minims] of glycerin, 600 mils [old form 28 fl. oz. 384 minims] of alcohol, and 200 mils [old form 9 fl. oz. 288 minims] of water, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator, add the remainder of the menstruum prepared, and, when this has just disappeared from the surface, gradually add a menstruum, prepared by mixing 2 volumes of alcohol and 1 volume of water, constantly maintaining a stratum of liquid above the drug. When the liquid begins to drop from the percolator, close the lower orifice and, having closely covered the percolator, macerate for forty-eight hours, and then allow the percolation to proceed slowly, gradually adding more of the second menstruum until the drug is exhausted. Reserve the first 750 mils [old form 36 fl. oz.] of the percolate, recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, assay a portion as directed below, and, from the result thus obtained, ascertain by calculation the amount of alkaloids in the remainder of the liquid and dilute this with enough of the second menstruum to make each 100 mils of the finished Fluidextract contain 2 Gm. of the ether-soluble alkaloids of hydrastis. (U. S. P. Type Process B.)

Assay.—Proceed as directed under *Fluidextractum Belladonnæ Radicis*, modifying the process there given by using 5 mils of Fluidextract of Hydrastis instead of 10 mils of the fluidextract of belladonna root and using only ether as the immiscible solvent throughout the assay. Dry the residue to constant weight at 100° C. (212° F.), instead of titrating it. The weight represents the amount of ether-soluble alkaloids in 5 mils of the Fluidextract of Hydrastis.

N. F. Preparation.—Mistura Rhei Alkalina.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM HYOSCYAMI. U. S. **Fluidextract of Hyoscyamus**
[Fldext. Hyosc. FLUID EXTRACT OF HYOSCYAMUS FLUIDEXTRACT OF HENBANE]

One hundred mils of Fluidextract of Hyoscyamus yields not less than 0.055 Gm. nor than 0.075 Gm. of the alkaloids of hyoscyamus.

	Metric	Old form
***Hyoscyamus**, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum prepared by mixing 3 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, assay a portion as directed below, and, from the result thus obtained, ascertain by calculation the amount of alkaloids in the remainder of the liquid and dilute this with enough menstruum to make each 100 mils of the finished Fluidextract contain 0.065 Gm. of the alkaloids of hyoscyamus. (U. S. P. Type Process A.)

Assay.—Proceed as directed under *Fluidextractum Belladonnæ Radicis*, modifying the process there given by using 25 mils of the Fluidextract of Hyoscyamus in place of 10 mils of fluidextract of belladonna root, and before titrating treating the residue twice with 5 mils of ether and evaporating to dryness each time.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 28.92 milligrammes of the total alkaloids of hyoscyamus.

Average dose.—3 minims (0.2 mil).

FLUIDEXTRACTUM IPECACUANHÆ. U. S. **Fluidextract of Ipecac**
[Fldext. Ipecac. FLUID EXTRACT OF IPECAC]

One hundred mils of Fluidextract of Ipecac yields not less than 1.8 Gm. nor more than 2.2 Gm. of the ether-soluble alkaloids of ipecac.

	Metric	Old form
***Ipecac**, in No. 60 powder	**1000 Gm.**	50 oz. av.
Diluted Hydrochloric Acid,		
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	2 pints

Moisten the powdered drug with a sufficient quantity of a menstruum prepared by mixing 100 mils [old form 4 fl. oz. 384 minims] of diluted hydrochloric acid, 200 mils [old form 9 fl. oz. 288 minims] of alcohol and 200 mils [old form 9 fl. oz. 288 minims] of water, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator, add the remainder of the menstruum prepared, and when this has just disappeared from the surface, gradually add a menstruum, prepared by mixing 2 volumes of alcohol and 3 volumes of water, constantly maintaining a stratum of liquid above the drug. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours, and then allow the percolation to proceed slowly, gradually adding more of the second menstruum until the drug is exhausted. Reserve the first 800 mils [old form 38½ fl. oz.] of the percolate, recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and assay a portion as directed below, and, from the result thus obtained, ascertain by calculation the amount of alkaloids in the remainder of the liquid and dilute this with enough of the second menstruum to make each 100 mils of the finished Fluidextract contain 2 Gm. of the ether-soluble alkaloids of ipecac. (U. S. P. Type Process B.)

Assay.—From a pipette drop 10 mils of Fluidextract of Ipecac evenly over the surface of 10 Gm. of purified sawdust (see Reagents, Chapter LXII), and evaporate it to dryness at a temperature not exceeding 80° C. (176° F.). Transfer the impregnated sawdust to a 250 mil flask and add 100 mils of ether. Rinse the dish in which the mixture was evaporated with 6 mils of ammonia water, previously diluted with an equal volume of water, used in several portions, and add the rinsings to the flask. Stopper the flask and shake it vigorously every few minutes, during two hours. Now add 15 mils of distilled water, again shake the flask well, and when the sawdust has subsided decant 50 mils of the ether solution, representing 5 mils of the Fluidextract. Completely extract the alkaloids from this solution by shaking out with weak sulphuric acid. Collect the acid washings in a separator; add ammonia water until the solution is decidedly alkaline to litmus, and completely extract the alkaloids by shaking out repeatedly with ether. Evaporate the combined ether washings to dryness, dissolve the alkaloid from the residue in exactly 10 mils of tenth-normal sulphuric acid V.S. and titrate the excess of acid with fiftieth-normal potassium hydroxide V.S., cochineal T.S. being used as indicator (see Proximate Assays, Chapter LXII).

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 24 milligrammes of the ether-soluble alkaloids of ipecac.

U. S. P. Preparation.—Syrupus Ipecacuanhæ.

N. F. Preparations.—Mistura Rhei Composita; Syrupus Asari Compositus; Syrupus Cimicifugæ Compositus; Tinctura Ipecacuanhæ et Opii; Vinum Ipecacuanhæ.

Average dose.—Expectorant, 1 minim (0.05 mil).

FLUIDEXTRACTUM LOBELIÆ. U. S. Fluidextract of Lobelia

[Fldext. Lobel. Fluid Extract of Lobelia]

	Metric	Old form
***Lobelia**, in No. 30 powder	**1000 Gm.**	50 oz. av.
Acetic Acid,		
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum

prepared by mixing 50 mils [old form 2 fl. oz. 192 minims] of acetic acid, 500 mils [old form 1½ pints] of alcohol, and 450 mils [old form 21 fl. oz. 288 minims] of water, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator, add the remainder of the menstruum prepared, and when this has just disappeared from the surface, gradually add diluted alcohol, constantly maintaining a stratum of liquid above the drug. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours, and then allow the percolation to proceed slowly, gradually adding more of the second menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate, recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the second menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process B.)

Average dose.—2½ minims (0.15 mil).

FLUIDEXTRACTUM NUCIS VOMICÆ. U. S. Fluidextract of Nux Vomica

[**Fldext. Nuc. Vom.** Fluid Extract of Nux Vomica]

One hundred mils of Fluidextract of Nux Vomica yields not less than 2.37 Gm. nor more than 2.63 Gm. of the alkaloids of nux vomica.

	Metric	Old form
***Nux Vomica,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum prepared by mixing 3 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 800 mils [old form 38½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, assay a portion as directed below, and, from the result thus obtained, ascertain by calculation the amount of alkaloids in the remainder of the liquid and dilute this with enough menstruum to make each 100 mils of the finished Fluidextract contain 2.5 Gm. of the alkaloids of nux vomica. (U. S. P. Type Process A.)

Assay.—Proceed as directed under *Fluidextractum Belladonnæ Radicis*, using 10 mils of Fluidextract of Nux Vomica, modifying the process there given by dissolving the alkaloidal residue in 10 mils of tenth-normal sulphuric acid V.S. instead of 5 mils.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 36.42 milligrammes of the alkaloids of nux vomica.

Average dose.—1 minim (0.05 mil).

FLUIDEXTRACTUM PILOCARPI. U. S. Fluidextract of Pilocarpus

[Fldext. Pilocarp. FLUID EXTRACT OF PILOCARPUS FLUIDEXTRACT OF JABORANDI]

One hundred mils of Fluidextract of Pilocarpus yields not less than 0.55 Gm. nor more than 0.65 Gm. of the alkaloids of pilocarpus.

	Metric	Old form
***Pilocarpus**, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum prepared by mixing 2 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 800 mils [old form 38½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, assay a portion as directed below, and, from the result thus obtained, ascertain by calculation the amount of alkaloids in the remainder of the liquid and dilute this with enough menstruum to make each 100 mils of the finished Fluidextract contain 0.6 Gm. of the alkaloids of pilocarpus. (U. S. P. Type Process A.)

Assay.—From a pipette drop 15 mils of Fluidextract of Pilocarpus evenly over the surface of 15 Gm. of purified sawdust (see Reagents, Chapter LXII), and evaporate it to dryness on a water bath. Transfer the mixture to a 250 mil flask, add 150 mils of chloroform, and proceed as directed under *Belladonnæ Radix*, third line of the Assay, beginning with the word "Stopper," modifying the process there given by increasing the amount of ammonia water to 6 mils, mixed with 5 mils of distilled water, which is to be used, in divided portions, to rinse the dish in which the mixture was evaporated, the rinsings being added to the mixture in the flask; the 100 mils of chloroform solution must be drawn off from the bottom of the flask.

Each mil of tenth-normal sulphuric acid V.S. corresponds to 20.815 milligrammes of the alkaloids of pilocarpus.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM PODOPHYLLI. U. S. Fluidextract of Podophyllum

[Fldext. Podophyll. FLUID EXTRACT OF PODOPHYLLUM]

	Metric	Old form
***Podophyllum**, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of alcohol to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

Average dose.—8 minims (0.5 mil).

FLUIDEXTRACTUM RHEI. U. S. Fluidextract of Rhubarb
[Fldext. Rhei FLUID EXTRACT OF RHUBARB]

	Metric	Old form
***Rhubarb**, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum prepared by mixing 4 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.), dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

U. S. P. Preparation.—Syrupus Rhei.

N. F. Preparations.—Elixir Catharticum Compositum; Mistura Rhei Alkalina; Mistura Rhei Composita; Syrupus Sennæ Compositus; Vinum Rhei Compositum.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM ROSÆ. U. S. Fluidextract of Rose
[Fldext. Rosæ FLUID EXTRACT OF ROSE]

	Metric	Old form
***Red Rose**, in No. 20 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of menstruum prepared by mixing 100 mils [old form 4 fl. oz. 384 minims] of glycerin, 500 mils [old form 1½ pint] of alcohol and 400 mils [old form 19 fl. oz. 96 minims] to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator, add the remainder of the menstruum prepared, and when this has just disappeared from the surface, gradually add diluted alcohol, constantly maintaining a stratum of liquid above the drug. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours, and then allow the percolation to proceed slowly, gradually adding more of the second menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate, recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the second menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process B.)

U. S. P. Preparation.—Mel Rosæ.
N. F. Preparation.—Syrupus Rosæ.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM SABAL. U. S. Fluidextract of Sabal

[Fldext. Sabal Fluid Extract of Sabal Fluidextract of Saw Palmetto]

	Metric	Old form
***Sabal,** in No. 20 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum prepared by mixing 4 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM SARSAPARILLÆ. U. S. Fluidextract of Sarsaparilla

[Fldext. Sarsap. Fluid Extract of Sarsaparilla]

	Metric	Old form
*Sarsaparilla, in No. 20 powder	1000 Gm.	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	1000 mils	3 pints

Moisten the powdered drug with a sufficient quantity of diluted alcohol to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

U. S. P. Preparation.—Syrupus Sarsaparillæ Compositus.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM SARSAPARILLÆ COMPOSITUM. U. S. Compound Fluidextract of Sarsaparilla

[Fldext. Sarsap. Co. Compound Fluid Extract of Sarsaparilla]

	Metric	Old form
*Sarsaparilla, No. 20 powder	750 Gm.	37 oz. av. 242 gr.
Glycyrrhiza, in No. 20 powder	120 Gm.	6 oz. av. 4 gr.
Sassafras, in No. 30 powder	100 Gm.	4 oz. av. 440 gr.
Mezereum, in No. 30 powder	30 Gm.	1 oz. av. 218 gr.
Glycerin,		
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	1000 mils	3 pints

Moisten the powdered drugs with a sufficient quantity of a menstruum prepared by mixing 100 mils [old form 4 fl. oz. 384 minims] of glycerin, 500 mils [old form 1½ pints] of alcohol and 400 mils [old form 19 fl. oz. 96 minims] of water, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator, add the remainder of the menstruum prepared, and when this has just disappeared from the surface, gradually add diluted alcohol, constantly maintaining a stratum of liquid above the drug. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours, and then allow the percolation to proceed slowly, gradually adding more of the second menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate, recover the alcohol from the remainder and concentrate the residue to a soft

extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the second menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process B.)

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM SCILLÆ. U. S. Fluidextract of Squill [Fldext. Scill. Fluid Extract of Squill]

If assayed biologically the minimum lethal dose should not be greater than 0.0006 mil of Fluidextract, or the equivalent in Fluidextract of 0.0000005 Gm. of ouabain, for each gramme of body weight of frog.

	Metric	Old form
***Squill,** in No. 20 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol,		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Mix 2000 mils [old form 6 pints] of alcohol with 1000 mils [old form 3 pints] of water, moisten the squill thoroughly with sufficient of the mixture and allow it to macerate for two hours in a tightly-covered container. Then transfer it to a percolator, shake it down evenly without packing, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum composed of 2 volumes of alcohol and 1 volume of water. When the percolate measures 1000 mils [old form 3 pints] close the lower orifice and macerate the drug twelve hours before continuing the percolation. Then collect a second 1000 mils [old form 3 pints] of percolate, again interrupt the percolation, macerate for twelve hours and then continue the percolation until the total percolate measures 5000 mils [old form 15 pints]. Recover the alcohol from the percolate at as low a temperature as possible and then concentrate the residue to a volume measuring 800 mils [old form 38½ fl. oz.]. When the residue is cold, add slowly, with continuous agitation, 2000 mils [old form 6 pints] of alcohol and set the mixture aside in a tightly-stoppered container for twelve hours. Decant the supernatant liquid from the syrupy layer, filter the decanted liquid and wash the syrupy residue with two portions of 300 mils [old form about 14½ fl. oz.] each of a mixture of 4 volumes of alcohol and 1 volume of water, passing the washings through the filter into the previously collected alcoholic liquid. Reduce the combined alcoholic liquids to 800 mils [old form about 38½ fl. oz.] by distillation and finally add enough diluted alcohol to make the finished Fluidextract measure 1000 mils [old form 3 pints].

Assay.—For a method of assaying Fluidextract of Squill see Biological Assays (Chapter LXII).

U. S. P. Preparation.—Syrupus Scillæ Compositus.

N. F. Preparation.—Mistura Pectoralis, Stokes.

Average dose.—1½ minims (0.1 mil).

FLUIDEXTRACTUM SENEGÆ. U. S. **Fluidextract of Senega**
[Fldext. Seneg. Fluid Extract of Senega]

	Metric	Old form
***Senega**, in No. 30 powder	**1000 Gm.**	50 oz. av.
Ammonia Water,		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Mix 2000 mils [old form 6 pints] of alcohol with 1000 mils [old form 3 pints] of water, and, having moistened the powder with sufficient of this mixture, pack it in a cylindrical percolator and add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, composed of a mixture of 2 volumes of alcohol and 1 volume of water, until the drug is exhausted. Reserve the first 800 mils [old form 38½ fl. oz.] of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved liquid and then gradually add ammonia water until the product is faintly alkaline and possesses a slight odor of ammonia. Finally add enough of the menstruum to make the Fluidextract measure 1000 mils [old form 3 pints].

U. S. P. Preparations.—Syrupus Scillæ Compositus; Syrupus Senegæ.

N. F. Preparations.—Mistura Pectoralis, Stokes; Syrupus Cimicifugæ Compositus.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM SENNÆ. U. S. **Fluidextract of Senna**
[Fldext. Senn. Fluid Extract of Senna]

	Metric	Old form
***Alexandria Senna**, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 1 volume of alcohol and 2 volumes of water, to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 800 mils [old form 38½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

U. S. P. Preparations.—Syrupus Sarsaparillæ Compositus; Syrupus Sennæ.

N. F. Preparations.—Elixir Cascaræ Sagradæ Compositum; Elixir Catharticum

Compositum; Syrupus Ficorum Compositus; Syrupus Sennæ Aromaticus; Syrupus Sennæ Compositus.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM SPIGELIÆ. U. S. **Fluidextract of Spigelia**

[**Fldext. Spigel.** Fluid Extract of Spigelia Fluidextract of Pink Root]

	Metric	Old form
***Spigelia,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of diluted alcohol to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

Average dose.—1 fluidrachm (5 mils).

FLUIDEXTRACTUM STAPHISAGRIÆ. U. S. **Fluidextract of Staphisagria**

[**Fldext. Staphisag.** Fluid Extract of Staphisagria Fluidextract of Stavesacre]

	Metric	Old form
***Staphisagria,** in No. 20 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of alcohol to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.) The oil which separates in the freshly prepared Fluidextract may be removed by chilling and filtering the cold Fluidextract through a filter moistened with alcohol.

FLUIDEXTRACTUM STILLINGIÆ. U. S. **Fluidextract of Stillingia**

[**Fldext. Stilling.** Fluid Extract of Stillingia]

	Metric	Old form
***Stillingia,** in No. 30 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of diluted alcohol to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

N. F. Preparation.—Elixir Corydalis Compositum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM SUMBUL. U. S. **Fluidextract of Sumbul**

[**Fldext. Sumbul** Fluid Extract of Sumbul Fluidextract of Musk Root]

	Metric	Old form
***Sumbul,** in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 4 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM TARAXACI. U. S. **Fluidextract of Taraxacum**

[**Fldext. Tarax.** FLUID EXTRACT OF TARAXACUM FLUIDEXTRACT OF DANDELION]

	Metric	Old form
***Taraxacum**, in No. 30 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 100 mils [old form 4 fl. oz. 384 minims] of glycerin, 500 mils [old form 1½ pints] of alcohol and 400 mils [old form 19 fl. oz. 96 minims] of water, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator, add the remainder of the menstruum prepared, and when this has just disappeared from the surface, gradually add diluted alcohol, constantly maintaining a stratum of liquid above the drug. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours, and then allow the percolation to proceed slowly, gradually adding more of the second menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate, recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the second menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process B.)

N. F. Preparations.—Elixir Gentianæ Glycerinatum; Elixir Taraxaci Compositum.

Average dose.—2½ fluidrachms (10 mils).

FLUIDEXTRACTUM TRITICI. U. S. **Fluidextract of Triticum**

[**Fldext. Tritic.** FLUID EXTRACT OF TRITICUM FLUIDEXTRACT OF COUCH GRASS]

	Metric	Old form
***Triticum**, finely cut	**1000 Gm.**	50 oz. av.
Alcohol	**200 mils**	9 fl. oz. 288 min.
Water, a sufficient quantity,		
To make	**1000 mils**	3 pints

Add 500 mils [old form 1½ pints] of boiling water to the ground drug, mix thoroughly and allow it to macerate in a covered container for two hours in a warm place. Then transfer the moist drug to a tinned or enameled metallic percolator and allow percolation to proceed, gradually adding boiling water until the drug is exhausted. Evaporate the percolate on a water bath or steam bath to 800 mils [old form 38½ fl. oz.] and when cold add the alcohol and, if necessary, sufficient water to make the product measure 1000 mils, and mix thoroughly. (U. S. P. Type Process D.)

Average dose.—2½ fluidrachms (10 mils).

FLUIDEXTRACTUM UVÆ URSI. U. S. **Fluidextract of Uva Ursi**
[Fldext. Uvæ Ursi FLUID EXTRACT OF UVA URSI]

	Metric	Old form
***Uva Ursi**, in No. 30 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 100 mils [old form 4 fl. oz. 384 minims] of glycerin, 300 mils [old form 14 fl. oz. 192 minims] of alcohol and 500 mils [old form 1½ pints] of water, to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator, add the remainder of the menstruum prepared, and, when this has just disappeared from the surface, gradually add a menstruum, prepared by mixing 1 volume of alcohol and 2 volumes of water, constantly maintaining a stratum of liquid above the drug. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours, and then allow the percolation to proceed slowly, gradually adding more of the second menstruum until the drug is exhausted. Reserve the first 800 mils [old form 38½ fl. oz.] of the percolate, recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the second menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process B.)

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM VERATRI VIRIDIS. U. S. **Fluidextract of Veratrum Viride**

[Fldext. Verat. Vir. FLUID EXTRACT OF VERATRUM VIRIDE FLUIDEXTRACT OF GREEN HELLEBORE]

	Metric	Old form
***Veratrum Viride**, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of alcohol, to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

Average dose.—1½ minims (0.1 mil).

FLUIDEXTRACTUM VIBURNI PRUNIFOLII. U. S. Fluidextract of Viburnum Prunifolium

[Fldext. Viburn. Prun. Fluid Extract of Viburnum Prunifolium Fluidextract of Black Haw]

	Metric	Old form
*Viburnum Prunifolium, in No. 30 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 mils	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 2 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

N. F. Preparation.—Elixir Viburni Prunifolii.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM XANTHOXYLI. U. S. Fluidextract of Xanthoxylum

[Fldext. Xanthox. Fluid Extract of Xanthoxylum Fluidextract of Prickly Ash

	Metric	Old form
*Xanthoxylum, in No. 30 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each a sufficient quantity,		
To make	1000 mils	3 pints

Moisten the powdered drug with a sufficient quantity of a menstruum, prepared by mixing 3 volumes of alcohol and 1 volume of water, to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils [old form 3 pints]. (U. S. P. Type Process A.)

N. F. Preparation.—Elixir Corydalis Compositum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM ZINGIBERIS. U. S. **Fluidextract of Ginger**
[Fldext. Zingib. FLUID EXTRACT OF GINGER]

	Metric	Old form
***Jamaica Ginger,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the powdered drug with a sufficient quantity of alcohol to render it evenly and distinctly damp and to maintain it so, after macerating for six hours in a tightly-covered container. Then pack it in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 mils [old form 40½ fl. oz.] of the percolate; recover the alcohol from the remainder and concentrate the residue to a soft extract at a temperature not exceeding 60° C. (140° F.); dissolve this in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to obtain 1000 mils. (U. S. P. Type Process A).

U. S. P. Preparation.—Syrupus Zingiberis.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM ADONIDIS. N. F. **Fluidextract of Adonis**
[Fldext. Adonid.]

	Metric	Old form
Adonis, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 3 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—2 minims (0.125 mil).

FLUIDEXTRACTUM ALETRIDIS. N. F. **Fluidextract of Aletris**
[Fldext. Aletrid.]

	Metric	Old form
Aletris, in No. 30 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

N. F. Preparation.—Elixir Viburni Opuli Compositum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM ANGELICÆ RADICIS. N. F. **Fluidextract of Angelica Root**

[Fldext. Angel. Rad.]

	Metric	Old form
Angelica Root, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using alcohol as the menstruum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM APII FRUCTUS. N. F. **Fluidextract of Celery Fruit**

[Fldext. Apii Fruct.]

	Metric	Old form
Celery Fruit, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using alcohol as the menstruum.

In order to remove any separated oil, after permitting the fluidextract to stand, filter it through an alcohol-wetted filter, rejecting the final few mils remaining on the filter with the oil.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM APOCYNI. N. F. **Fluidextract of Apocynum**

[Fldext. Apocyn.]

	Metric	Old form
Apocynum, in No. 30 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process B (see page 521), using a mixture of 100 mils [old form 4 fl. oz. 384 minims] of glycerin, 600 mils [old form 28 fl. oz. 384 minims] of alcohol, and 300 mils [old form 14 fl. oz. 192 minims] of water as Menstruum I, and a mixture of 3 volumes of alcohol and 2 volumes of water as Menstruum II.

Assay.—For a method of assaying Fluidextract of Apocynum see Biological Assays (Chapter LXII).

Average dose.—12 minims (0.75 mil).

CAUTION.—It has been stated that the absorption of Apocynum in the gastro-intestinal tract is uncertain and irregular. To avoid an accumulation of the drug or toxic action, the physician should carefully guard the dosage and determine in each case the tolerance of the patient.

FLUIDEXTRACTUM ARALIÆ. N. F. **Fluidextract of Aralia**

[Fldext. Aral.]

	Metric	Old form
Aralia, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 2 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM ARNICÆ. N. F. **Fluidextract of Arnica**

[Fldext. Arnic.]

	Metric	Old form
Arnica, in No. 20 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—1½ minims (0.1 mil).

FLUIDEXTRACTUM ASCLEPIADIS. N. F. **Fluidextract of Asclepias**

[Fldext. Asclepiad.]

	Metric	Old form
Asclepias, in No. 30 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM BAPTISIÆ. N. F. **Fluidextract of Baptisia**

[Fldext. Baptis.]

	Metric	Old form
Baptisia, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 3 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM BERBERIDIS. N. F. Fluidextract of Berberis

(U S.P.VIII)

[Fldext. Berberid.]

	Metric	Old form
Berberis, in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM BOLDI. N. F. Fluidextract of Boldo

[Fldext. Boldi]

	Metric	Old form
Boldo, in No. 20 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using alcohol as the menstruum.

Average dose.—8 minims (0.5 mil).

FLUIDEXTRACTUM BUCHU COMPOSITUM. N. F. Compound Fluidextract of Buchu

[Fldext. Buchu Co.]

	Metric	Old form
Buchu, in No. 40 powder	**625 Gm.**	31 oz. av. 30 gr.
Cubeb, in No. 40 powder	**125 Gm.**	6 oz. av. 114 gr.
Juniper Berries, in No. 20 powder	**125 Gm.**	6 oz. av. 114 gr.
Uva Ursi, in No. 40 powder	**125 Gm.**	6 oz. av. 114 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 2 volumes of alcohol and 1 volume of water as the menstruum.

N. F. Preparation.—Elixir Buchu Compositum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM CALENDULÆ. N. F. Fluidextract of Calendula

[Fldext. Calend.]

	Metric	Old form
Calendula, in No. 20 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using alcohol as the menstruum.

FLUIDEXTRACTUM CALUMBÆ. N. F. **Fluidextract of Calumba**
(U.S.P. VIII)

[Fldext. Calumb.]

	Metric	Old form
Calumba, in No. 20 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process B (see page 521), using a mixture of 100 mils [old form 4 fl. oz. 384 minims] of glycerin, 800 mils [old form 38 fl. oz. 192 minims] of alcohol and 100 mils [old form 4 fl. oz. 384 minims] of water as Menstruum I, and a mixture of 4 volumes of alcohol and 1 volume of water as Menstruum II.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM CASTANEÆ. N. F. **Fluidextract of Chestnut Leaves**

[Fldext. Castan.]

	Metric	Old form
Castanea, in No. 30 powder	**1000 Gm.**	50 oz. av.
Glycerin	**100 mils**	4 fl. oz. 384 min.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Pour 5000 mils [old form 15 pints] of boiling water upon the powder, allow it to macerate two hours, then express the liquid, transfer the residue to a percolator, and pour water upon it until the powder is practically exhausted. Evaporate the united liquids, on a water bath, to 2000 mils [old form 6 pints], allow it to cool, and add 600 mils [old form 28 fl. oz. 384 minims] of alcohol. When the insoluble matter has subsided, separate the clear liquid, filter the remainder, evaporate the united liquids to 700 mils [old form 33 fl. oz. 288 minims], allow it to cool, add the glycerin, and, lastly, enough alcohol to make the Fluidextract measure 1000 mils [old form 3 pints].

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM CATARIÆ. N. F. **Fluidextract of Catnep**

[Fldext. Catar.]

	Metric	Old form
Catnep, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 3 volumes of alcohol and 4 volumes of water as the menstruum.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM CAULOPHYLLI. N. F. Fluidextract of Caulophyllum

[Fldext. Caulophyl.]

	Metric	Old form
Caulophyllum, in No. 60 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 3 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—8 minims (0.5 mil).

FLUIDEXTRACTUM CHIMAPHILÆ. N. F. Fluidextract of Chimaphila

(U. S. P. VIII)

[Fldext. Chimaphil.]

	Metric	Old form
Chimaphila, in No. 30 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM CHIONANTHI. N. F. Fluidextract of Chionanthus

[Fldext. Chionanth.]

	Metric	Old form
Chionanthus, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 3 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM CHIRATÆ. N. F. Fluidextract of Chirata

(U.S.P. VIII)

[Fldext. Chirat.]

	Metric	Old form
Chirata, in No. 30 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM CINCHONÆ AQUOSUM. N. F. Aqueous Fluidextract of Cinchona

[Fldext. Cinchon. Aq.]

One hundred milliliters of Aqueous Fluidextract of Cinchona yields not less than 4.5 Gm. nor more than 5.5 Gm. of the alkaloids of cinchona and not less than 12 per cent. of alcohol, by volume.

	Metric	Old form
Red Cinchona, in No. 40 powder	**1000 Gm.**	50 oz. av.
Hydrochloric Acid	**30 mils**	1 fl. oz. 211 min.
Glycerin	**125 mils**	6 fl. oz.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	3 pints

Mix the hydrochloric acid and glycerin with 5000 mils [old form 15 pints] of water and moisten the powder with 350 mils [old form 16 fl. oz. 384 minims] of the mixture. Pack the moistened drug in a cylindrical percolator, pour on additional menstruum, and, when the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly until the drug is practically exhausted, first using the remainder of the menstruum prepared above and then a sufficient quantity of water.

Reserve the first 700 mils [old form 33 fl. oz. 288 minims] of the percolate, and evaporate the remainder to 400 mils [old form about 19 fl. oz.] at a temperature not exceeding 80° C. (176° F.); then add the reserved portion and continue the evaporation until the mixed liquid measures 700 mils [old form 33 fl. oz. 288 minims].

Assay 5 mils of this liquid as directed below and, from the result thus obtained, ascertain by calculation the amount of total cinchona alkaloids in the remainder of the liquid and add enough water and alcohol to make the finished Fluidextract contain 12 per cent., by volume, of absolute alcohol, and 5 Gm. of the total alkaloids of cinchona in each 100 mils.

Assay.—From a pipette drop 5 mils of Aqueous Fluidextract of Cinchona evenly over the surface of 10 Gm. of purified sawdust and evaporate it to dryness at a temperature not exceeding 80° C. (176° F.). Transfer the mixture to a 500-mil flask and add 200 mils of a mixture of chloroform, 1 volume, and ether, 2 volumes. Stopper the flask, shake it well, and let it stand ten minutes. Then rinse the dish with 10 mils of ammonia water in divided portions, adding the rinsings to the flask, shake the flask frequently for one hour, and, when it has settled, decant 160 mils of the solution, representing 4 mils of the Fluidextract. Filter it through a pledget of purified cotton into a separator, and rinse both cylinder and cotton with ether. Completely extract the alkaloids from the chloroform-ether solution by shaking out repeatedly with weak sulphuric acid. Collect the acid solutions in a separator, add ammonia water until the solution is distinctly alkaline to litmus, and completely extract the alkaloids by shaking out repeatedly with chloroform. Filter each portion of chloroform as it comes from the separator through a pledget of purified cotton into a tared flask, and wash the funnel and cotton with chloroform. Evaporate off the chloroform, add 5 mils of alcohol to the residue, and again evaporate. Repeat the evaporation with alcohol and dry the residue at 100° C. (212° F.) to constant weight. The weight will be the amount of total alkaloids from 4 mils of the Fluidextract.

Determine the percentage of alcohol by the method given in the U. S. Pharmacopœia IX (see Chapter LXII).

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM COCILLANÆ. N. F. Fluidextract of Cocillana

[Fldext. Cocillan.]

	Metric	Old form
Cocillana, in No. 20 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 3 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM COFFEÆ. N. F. Fluidextract of Coffee

[Fldext. Coff. FLUIDEXTRACTUM COFFEÆ TOSTÆ, N. F. III]

	Metric	Old form
Coffee, in No. 20 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process B (see page 521), using a mixture of 65 mils [old form 3 fl. oz. 57 minims] of glycerin, 250 mils [old form 12 fl. oz.] of alcohol, 685 mils [old form 32 fl. oz. 423 minims] of water, as Menstruum I and a mixture of 1 volume of alcohol and 3 volumes of water as Menstruum II.

Average dose.—30 minims (2 mils)

FLUIDEXTRACTUM COLCHICI CORMI. N. F. Fluidextract of Colchicum Corm

[Fldext. Colch. Corm]

One hundred milliliters of Fluidextract of Colchicum Corm yields not less than 0.31 Gm. nor more than 0.39 Gm. of colchicine.

	Metric	Old form
Colchicum Corm, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A as modified for assayed fluidextracts (see page 521), using a mixture of 2 volumes of alcohol and 1 volume of water as the menstruum. Moisten the powdered drug with 350 mils [old form 16½ fl. oz.] of this mixture.

After dissolving the soft extract in the reserve, assay 15 mils of this liquid as directed below and, from the result thus obtained, ascertain by calculation the amount of colchicine in the remainder of the liquid and add sufficient menstruum to make the finished Fluidextract contain 0.35 Gm. of colchicine in each 100 mils.

Assay.—Introduce 15 mils of Fluidextract of Colchicum Corm into a 500-mil flask, add 10 mils of solution of lead subacetate, previously diluted with 35 mils of distilled water, shake the mixture thoroughly, then add 240 mils of distilled water and again agitate the mixture. Weigh the flask and contents, and digest the mixture at from 60° to 70° C. (140° to 158° F.) for three hours, with occasional agitation. Cool, add distilled water to restore the original weight and filter off 200 mils. Add 0.75 Gm. of sodium phosphate to the clear filtrate, shake the mixture frequently during half an hour, and filter off 100 mils representing 5 mils of the Fluidextract. Shake out the alkaloid from the filtrate with chloroform until completely extracted, as shown by testing with iodine T.S. in place of the usual mercuric potassium iodide T.S., and evaporate the chloroform solution, adding about 1 mil of alcohol and again evaporating. Repeat this operation once more and dry the residue to constant weight at 100° C. (212° F.). To this weighed residue contained in a flask add 5 mils of approximately tenth-normal sulphuric acid V.S. and 5 mils of distilled water and heat the mixture for ten minutes to 70° C. (158° F.). Now filter the liquid through a pledget of purified cotton, and wash the flask and cotton with distilled water, rejecting the filtrate and washings and removing as much of the water from the cotton as possible. Dissolve any insoluble residue that may remain on the cotton by washing it first with a little alcohol and then with ether; collect the alcohol-ether washings in the flask, evaporate, and dry the residue to constant weight at 100° C. (212° F.). Deduct this weight from the weight of residue previously obtained. The difference will be the weight of colchicine obtained from 5 mils of Fluidextract of Colchicum Corm.

Average dose.—3 minims (0.2 mil).

FLUIDEXTRACTUM CONDURANGO. N. F. Fluidextract of Condurango

[Fldext. Condurango]

	Metric	Old form
Condurango, in No. 30 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM CONII. N. F. Fluidextract of Conium

(U.S.P. VIII)

[Fldext. Conii]

One hundred milliliters of Fluidextract of Conium yields not less than 0.35 Gm. nor more than 0.45 Gm. of coniine.

	Metric	Old form
Conium, in No. 40 powder	**1000 Gm.**	50 oz.av.
Acetic Acid,		
Alcohol, each, a sufficient quantity,		
To make about	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process C as modified for assayed fluidextracts (see page 524), using first a mixture of 20 mils [old form 460 minims] of acetic acid and 980 mils [old form 47 fl. oz. 19 minims] of diluted alcohol as the menstruum and continuing with diluted alcohol.

Assay 10 mils of this liquid as directed below, and, from the result thus obtained, ascertain by calculation the amount of alkaloid in the remainder of the liquid. Add to this enough menstruum to make the finished Fluidextract contain 0.4 Gm. of coniine in each 100 mils.

Assay.—Transfer 10 mils of Fluidextract of Conium by means of a graduated pipette to an evaporating dish. Add 5 drops of diluted hydrochloric acid and evaporate to about 3 mils. Transfer this liquid to a separator, rinse the dish with a few drops of distilled water, and shake the liquid with 25 mils of purified petroleum benzin. When the liquids have separated, reject the benzin solution, and repeat the extraction with two more portions of purified petroleum benzin, rejecting the benzin solutions each time. Then add to the aqueous portion a slight excess of sodium carbonate and extract the alkaline fluid with successive portions of purified petroleum benzin until the alkaloid is entirely removed. Filter the benzin washings from the alkaline solution, add to the filtrate from a burette 5 mils of tenth-normal sulphuric acid V.S. and shake the liquids together. Evaporate off the benzin layer at a gentle heat, and titrate the excess of acid present with fiftieth-normal potassium hydroxide V.S., using cochineal T.S. or methyl red T.S as indicator. Each milliliter of tenth-normal sulphuric acid V.S. consumed corresponds to 0.0127 Gm. of coniine.

Average dose.—3 minims (0.2 mil).

FLUIDEXTRACTUM CONVALLARIÆ FLORUM. N. F. Fluidextract of Convallaria Flowers

[Fldext. Conval. Flor. FLUIDEXTRACTUM CONVALLARIÆ, N. F. III]

	Metric	Old form
Convallaria Flowers, in No. 40 powder.....	**1000 Gm.**	**50 oz. av.**
Alcohol,		
Water, each, a sufficient quantity,		
To make.....	**1000 mils**	**3 pints**

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 2 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—8 minims (0.5 mil).

FLUIDEXTRACTUM CONVALLARIÆ RADICUS. N. F. Fluidextract of Convallaria Root

[Fldext. Conval. Rad.]

	Metric	Old form
Convallaria Root, in No. 30 powder.....	**1000 Gm.**	**50 oz. av.**
Alcohol,		
Water, each, a sufficient quantity,		
To make.....	**1000 mils**	**3 pints**

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 3 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—8 minims (0.5 mil).

FLUIDEXTRACTUM COPTIS. N. F. Fluidextract of Coptis

[Fldext. Copt.]

	Metric	Old form
Coptis, in No. 40 powder.....	**1000 Gm.**	**50 oz. av.**
Diluted Alcohol, a sufficient quantity,		
To make.....	**1000 mils**	**3 pints**

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM CORNI. N. F. **Fluidextract of Cornus**

[Fldext. Corni]

	Metric	Old form
Cornus, in No. 30 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process B (see page 521), using a mixture of 150 mils [old form 7 fl. oz. 96 minims] of glycerin and 850 mils [old form 40 fl. oz. 384 minims] of diluted alcohol as Menstruum I and diluted alcohol as Menstruum II.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM CORYDALIS. N. F. **Fluidextract of Corydalis**

[Fldext. Corydal.]

	Metric	Old form
Corydalis, in No. 20 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 3 volumes of alcohol and 1 volume of water as the menstruum.

N. F. Preparation.—Elixir Corydalis Compositum.

Average dose.—10 minims (0.65 mil).

FLUIDEXTRACTUM CUBEBÆ. N. F. **Fluidextract of Cubeb**

(U.S.P. VIII)

[Fldext. Cubeb.]

	Metric	Old form
Cubeb, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using alcohol as the menstruum.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM CYPRIPEDII. N. F. **Fluidextract of Cypripedium**

(U.S P. VIII)

[Fldext. Cypriped.]

	Metric	Old form
Cypripedium, in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM DAMIANÆ. N. F. **Fluidextract of Damiana**
[Fldext. Damian. FLUIDEXTRACTUM TURNERÆ, N. F. III]

	Metric	Old form
Damiana, in No. 30 powder	**1000 Gm.**	50 oz av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 3 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM DIOSCOREÆ. N. F. **Fluidextract of Dioscorea**
[Fldext. Dioscor.]

	Metric	Old form
Dioscorea, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 4 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM DROSERÆ. N. F. **Fluidextract of Drosera**
[Fldext. Droser.]

	Metric	Old form
Drosera, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 2 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM DULCAMARÆ. N. F. **Fluidextract of Bittersweet**
[Fldext. Dulcam.]

	Metric	Old form
Bittersweet, in No. 30 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM ECHINACEÆ. N. F. **Fluidextract of Echinacea**
[Fldext. Echin.]

	Metric	Old form
Echinacea, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 4 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM EUONYMI. N. F. **Fluidextract of Euonymus**
(U.S.P. VIII)
[Fldext. Euonym.]

	Metric	Old form
Euonymus, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 4 volumes of alcohol and 1 volume of water as the menstruum and reserving the first 800 mils [old form 38½ fl. oz.] of the percolate.

Average dose.—8 minims (0.5 mil).

CAUTION.—It has been stated that the absorption of Euonymus in the gastro-intestinal tract is uncertain and irregular. To avoid an accumulation of the drug or toxic action, the physician should carefully guard the dosage and determine in each case the tolerance of the patient.

FLUIDEXTRACTUM EUPATORII. N. F. **Fluidextract of Eupatorium**
(U.S.P. VIII)
[Fldext. Eupator.]

	Metric	Old form
Eupatorium, in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum and reserving the first 800 mils [old form 38½ fl. oz.] of the percolate.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM EUPHORBIÆ PILULIFERÆ. N. F. **Fluidextract of Euphorbia Pilulifera**
[Fldext. Euphorb. Pilul.]

	Metric	Old form
Euphorbia Pilulifera, in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM FUCI. N. F. Fluidextract of Fucus

[Fldext. Fuci]

	Metric	Old form
Fucus, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 3 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—10 minims (0.65 mil).

FLUIDEXTRACTUM GALEGÆ. N. F. Fluidextract of Galega

[Fldext. Galeg.]

	Metric	Old form
Galega, in No. 30 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM GERANII. N. F. Fluidextract of Geranium

(U.S.P. VIII)

[Fldext. Geran.]

	Metric	Old form
Geranium, in No. 30 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process B (see page 521), using a mixture of 100 mils [old form 4 fl. oz. 384 minims] of glycerin, 600 mils [old form 28 fl. oz. 384 minims] of alcohol and 300 mils [old form 14 fl. oz. 192 minims] of water as Menstruum I and a mixture of 3 volumes of alcohol and 2 volumes of water as Menstruum II. Reserve the first 800 mils [old form 38½ fl. oz.] of the percolate.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM GOSSYPII CORTICIS. N. F. Fluidextract of Cotton Root Bark

[Fldext. Gossyp. Cort.]

	Metric	Old form
Cotton Root Bark, in No. 20 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using alcohol as the menstruum and reserving the first 800 mils [old form 38½ fl. oz.] of the percolate.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM HAMAMELIDIS FOLIORUM. N. F. **Fluidextract of Hamamelis Leaves**

[Fldext. Hamamel. Fol.]

	Metric	Old form
Hamamelis Leaves, in No. 30 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process B (see page 521), using a mixture of 100 mils [old form 4 fl. oz. 384 minims] of glycerin, 300 mils [old form 14 fl. oz. 192 minims] of alcohol, and 500 mils [old form 24 fl. oz.] of water as Menstruum I and a mixture of 1 volume of alcohol and 2 volumes of water as Menstruum II.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM HELIANTHEMI. N. F. **Fluidextract of Helianthemum**

[Fldext. Helianth.]

	Metric	Old form
Helianthemum, in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM HELONIATIS. N. F. **Fluidextract of Helonias**

[Fldext. Helon.]

	Metric	Old form
Helonias, in No. 30 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM HUMULI. N. F. **Fluidextract of Hops**

[Fldext. Humul.]

	Metric	Old form
Hops, in No. 20 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 5 volumes of alcohol and 3 volumes of water as the menstruum and reserving the first 800 mils [old form 38½ fl. oz.] of the percolate.

N. F. Preparation.—Elixir Humuli.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM HYDRANGEÆ. N. F. **Fluidextract of Hydrangea**

[Fldext. Hydrang.]

	Metric	Old form
Hydrangea, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 3 volumes of alcohol and 2 volumes of water as the menstruum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM IRIDIS VERSICOLORIS. N. F. **Fluidextract of Blue Flag**

[Fldext. Iri. Ver.]

	Metric	Old form
Blue Flag, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using alcohol as the menstruum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM JALAPÆ. N. F. **Fluidextract of Jalap**

[Fldext. Jalap.]

	Metric	Old form
Jalap, in No. 60 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by intimately mixing the ground drug with 1500 Gm. [old form 75 oz. av.] of clean sand and proceeding as directed under Type Process A (see page 521), using alcohol as the menstruum.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM JUGLANDIS. N. F. **Fluidextract of Juglans**

[Fldext. Jugland.]

	Metric	Old form
Juglans, in No. 40 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process B (see page 521), using a mixture of 100 mils [old form 4 fl. oz. 384 minims] of glycerin, 500 mils [old form 24 fl. oz.] of alcohol and 400 mils [old form 19 fl. oz. 96 minims] of water as Menstruum I and diluted alcohol as Menstruum II.

N. F. Preparation.—Elixir Cascaræ Sagradæ Compositum.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM JUNIPERI. N. F. **Fluidextract of Juniper Berries**

[Fldext. Junip.]

	Metric	Old form
Juniper Berries, in No. 20 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

N. F. Preparation.—Elixir Potassii Acetatis et Juniperi.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM KAVÆ. N. F. **Fluidextract of Kava**

[Fldext. Kav.]

	Metric	Old form
Kava, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 3 volumes of alcohol and 2 volumes of water as the menstruum.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM KOLÆ. N. F. **Fluidextract of Kola**

[Fldext. Kol. FLUIDEXTRACTUM STERCULIÆ, N. F. III]

	Metric	Old form
Kola, in No. 20 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 2 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM KRAMERIÆ. N. F. **Fluidextract of Krameria**

(U.S.P. VIII)

[Fldext. Kramer.]

	Metric	Old form
Krameria, in No. 40 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process B (see page 521), using a mixture of 100 mils [old form 4 fl. oz. 384 minims] of glycerin, 500 mils [old form 24 fl. oz.] of alcohol and 400 mils [old form 19 fl. oz. 96 minims] of water as Menstruum I, and diluted alcohol as Menstruum II. Reserve the first 800 mils [old form 38½ fl. oz.] of the percolate.

N. F. Preparation.—Syrupus Krameriæ.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM LAPPÆ. N. F. Fluidextract of Lappa

(U.S.P. VIII)

[Fldext. Lapp.]

	Metric	Old form
Lappa, in No. 30 powder	1000 Gm.	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	1000 mils	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum and reserving the first 800 mils [old form 38½ fl. oz.] of the percolate.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM LEPTANDRÆ. N. F. Fluidextract of Leptandra

(U.S.P. VIII)

[Fldext. Leptand.]

	Metric	Old form
Leptandra, in No. 30 powder	1000 Gm.	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	1000 mils	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM LUPULINI. N. F. Fluidextract of Lupulin

(U. S. P. VIII)

[Fldext. Lupulin.]

	Metric	Old form
Lupulin	1000 Gm.	50 oz. av.
Alcohol, a sufficient quantity,		
To make	1000 mils	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using alcohol as the menstruum.

Average dose.—8 minims (0.5 mil).

FLUIDEXTRACTUM MATICO. N. F. Fluidextract of Matico

(U.S.P. VIII)

[Fldext. Matic.]

	Metric	Old form
Matico, in No. 40 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 mils	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 3 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM MEZEREI. N. F. **Fluidextract of Mezereum**
(U.S.P. VIII)
[Fldext. Mezer.]

	Metric	Old form
Mezereum, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 4 volumes of alcohol and 1 volume of water as the menstruum.

N. F. Preparation.—Linimentum Sinapis Compositum.

FLUIDEXTRACTUM PARACOTO. N. F. **Fluidextract of Paracoto**
[Fldext. Paracot. FLUIDEXTRACTUM COTO, N. F. III]

	Metric	Old form
Paracoto, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 9 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—5 minims (0.3 mil).

FLUIDEXTRACTUM PAREIRÆ. N. F. **Fluidextract of Pareira**
(U.S.P. VIII)
[Fldext. Pareir.]

	Metric	Old form
Pareira, in No. 30 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM PETROSELINI RADICIS. N. F. **Fluidextract of Parsley Root**
[Fldext. Petrosel. Rad.]

	Metric	Old form
Parsley Root, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 2 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM PHYTOLACCÆ. N. F. **Fluidextract of Phytolacca**
(U.S.P. VIII)
[Fldext. Phytolac.]

	Metric	Old form
Phytolacca, in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum and reserving the first 800 mils [old form 38½ fl. oz.] of the percolate.

Average dose. { Emetic, 15 minims (1 mil).
Alterative, 1½ minims (0.1 mil).

FLUIDEXTRACTUM PRUNI VIRGINIANÆ. N. F. **Fluidextract of Wild Cherry**
(U.S.P. VIII)
[Fldext. Prun. Virg.]

	Metric	Old form
Wild Cherry, in No. 20 powder	**1000 Gm.**	50 oz. av.
Glycerin	**200 mils**	9 fl. oz. 288 min.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Moisten the drug with a mixture of the glycerin and 400 mils [old form 19 fl. oz. 96 minims] of water, pack loosely in a cylindrical percolator and macerate for twenty-four hours. Then add a mixture of 250 mils [old form 12 fl. oz.] of alcohol and 150 mils [old form 7 fl. oz. 96 minims] of water, macerate for twenty-four hours longer and then percolate slowly with a mixture of 1 volume of alcohol and 3 volumes of water until the drug is practically exhausted.

Reserve the first 850 mils [old form 40½ fl. oz.] of percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion and add enough of a mixture of 1 volume of alcohol and 3 volumes of water to make the Fluidextract measure 1000 mils [old form 3 pints].

N. F. Preparations.—Elixir Taraxaci Compositum; Emulsum Olei Morrhuæ cum Pruno Virginiana.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM QUASSIÆ. N. F. **Fluidextract of Quassia**
(U.S.P. VIII)
[Fldext. Quass.]

	Metric	Old form
Quassia, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 1 volume of alcohol and 2 volumes of water as the menstruum.

Average dose.—8 minims (0.5 mil).

FLUIDEXTRACTUM QUERCUS. N. F. Fluidextract of Quercus

(U.S.P. VIII)

[Fldext. Querc.]

	Metric	Old form
Quercus, in No. 40 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process B (see page 521), using a mixture of 100 mils [old form 4 fl. oz. 384 minims] of glycerin, 500 mils [old form 24 fl. oz.] of alcohol and 400 mils [old form 19 fl. oz. 96 minims] of water as Menstruum I and diluted alcohol as Menstruum II. Reserve the first 700 mils [old form 33½ fl. oz.] of the percolate.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM RHAMNI CATHARTICÆ. N. F. Fluidextract of Rhamnus Cathartica

[Fldext. Rham. Cathart.]

	Metric	Old form
Rhamnus Cathartica, in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum and reserving the first 750 mils [old form 36 fl. oz.] of the percolate.

N. F. Preparation.—Syrupus Rhamni Catharticæ.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM RHOIS GLABRÆ. N. F. Fluidextract of Rhus Glabra

(U.S.P. VIII)

[Fldext. Rhois Glab.]

	Metric	Old form
Rhus Glabara, in No. 20 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process B (see page 521), using a mixture of 100 mils [old form 4 fl. oz. 384 minims] of glycerin, 500 mils [old form 24 fl. oz.] of alcohol and 400 mils [old form 19 fl. oz. 96 minims] of water as Menstruum I, and diluted alcohol as Menstruum II.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM RUBI. N. F. Fluidextract of Rubus
(U.S.P. VIII)
[Fldext. Rubi]

	Metric	Old form
Rubus, in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum and reserving the first 800 mils [old form 38½ fl. oz.] of the percolate.

N. F. Preparation.—Syrupus Rubi.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM RUMICIS. N. F. Fluidextract of Rumex
[Fldext. Rumic.]

	Metric	Old form
Rumex, in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by moistening the ground drug with 350 mils [old form 16½ fl. oz.] of diluted alcohol and then proceeding as directed in Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM SANGUINARIÆ. N. F. Fluidextract of Sanguinaria
(Replacing U. S. P. VIII)
[Fldext. Sanguin.]

	Metric	Old form
Sanguinaria, in No. 30 powder	**1000 Gm.**	50 oz. av.
Citric Acid,		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process B (see page 521), using 100 Gm. [old form 4 oz. av. 462 grains] of citric acid dissolved in sufficient water to measure 250 mils [old form 12 fl. oz.] and mixed with 750 mils [old form 36 fl. oz.] of alcohol as Menstruum I and a mixture of 3 volumes of alcohol and 1 volume of water as Menstruum II.

Average dose.—1½ minims (0.1 mil).

FLUIDEXTRACTUM SCOPARII. N. F. Fluidextract of Scoparius
[Fldext. Scopar.]

	Metric	Old form
Scoparius, in No. 30 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum and reserving the first 750 mils [old form 36 fl. oz.] of the percolate.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM SCUTELLARIÆ. N. F. **Fluidextract of Scutellaria**
(U.S.P. VIII)
[Fldext. Scutellar.]

	Metric	Old form
Scutellaria, in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum and reserving the first 800 mils [old form 38½ fl. oz.] of the percolate.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM SENECIONIS. N. F. **Fluidextract of Senecio**
[Fldext. Senecion.]

	Metric	Old form
Senecio, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 2 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM SERPENTARIÆ. N. F. **Fluidextract of Serpentaria**
(U.S.P. VIII)
[Fldext. Serpentar.]

	Metric	Old form
Serpentaria, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 4 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM SOLANI. N. F. **Fluidextract of Solanum**
[Fldext. Solan.]

	Metric	Old form
Solanum, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 2 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM STILLINGIÆ COMPOSITUM. N. F. Compound Fluidextract of Stillingia

[Fldext. Stilling. Co.]

	Metric	Old form
Stillingia, in No. 30 powder	**250 Gm.**	12 oz. av. 226 gr.
Corydalis, in No. 30 powder	**250 Gm.**	12 oz. av. 226 gr.
Blue Flag, in No. 30 powder	**125 Gm.**	6 oz. av. 113 gr.
Sambucus, in No. 30 powder	**125 Gm.**	6 oz. av. 113 gr.
Chimaphila, in No. 30 powder	**125 Gm.**	6 oz. av. 113 gr.
Coriander, in No. 30 powder	**63 Gm.**	3 oz. av. 67 gr.
Prickly Ash Berries, in No. 30 powder	**62 Gm.**	3 oz. av. 45 gr.
Glycerin,		
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process B (see page 521), using a mixture of 250 mils [old form 12 fl. oz.] of glycerin, 500 mils [old form 24 fl. oz.] of alcohol and 250 mils [old form 12 fl. oz.] of water as Menstruum I, and diluted alcohol as Menstruum II.

N. F. Preparation.—Syrupus Stillingiæ Compositus.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM STRAMONII. N. F. Fluidextract of Stramonium (U.S.P.VIII)

[Fldext. Stramon.]

One hundred milliliters of Fluidextract of Stramonium yields not less than 0.22 Gm. nor more than 0.28 Gm. of the alkaloids of stramonium.

	Metric	Old form
Stramonium, in No. 40 Powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 2 volumes of alcohol and 1 volume of water as the menstruum.

After dissolving the soft extract in the reserve assay 10 mils of this liquid as directed below, and, from the result thus obtained, ascertain by calculation the amount of alkaloids in the remainder of the liquid and add to this enough menstruum to make the finished Fluidextract contain 0.25 Gm. of the alkaloids of stramonium in each 100 mils.

Assay.—Introduce 10 mils of Fluidextract of Stramonium into a separator and add 10 mils of distilled water and 2 mils of ammonia water. Completely extract the alkaloids by shaking out repeatedly with chloroform and then extract the alkaloids from the chloroform solution by shaking out repeatedly with weak sulphuric acid until the alkaloid is completely removed. Collect the acid washings in a separator, add ammonia water until the solution is decidedly alkaline to litmus, and completely extract the alkaloid by shaking out repeatedly with chloroform. Evaporate the combined chloroform washings to dryness, dissolve the alkaloids from the residue in exactly 5 mils of tenth-normal sulphuric acid V.S. and titrate the excess of acid with fiftieth-normal potassium hydroxide V.S., using cochineal T.S. as indicator.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 28.92 milligrammes of the alkaloids of stramonium.

Average dose.—1 minim (0.05 mil).

FLUIDEXTRACTUM THUJÆ. N. F. **Fluidextract of Thuja**
[Fldext. Thuj.]

	Metric	Old form
Thuja, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using alcohol as the menstruum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM THYMI. N. F. **Fluidextract of Thyme**
[Fldext. Thym.]

	Metric	Old form
Thyme, in No. 30 powder	**1000 Gm.**	50 oz. av.
Glycerin,		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process B (see page 521), using a mixture of 100 mils [old form 4 fl. oz. 384 minims] of glycerin, 250 mils [old form 12 fl. oz.] of alcohol and 650 mils [old form 31 fl. oz. 96 minims] of water as Menstruum I and a mixture of 1 volume of alcohol and 3 volumes of water as Menstruum II.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM TRIFOLII. N. F. **Fluidextract of Trifolium**
[Fldext. Trifol.]

	Metric	Old form
Trifolium, in No. 30 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum and reserving the first 800 mils [old form 38½ fl. oz.] of the percolate.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM TRILLII. N. F. **Fluidextract of Trillium**
[Fldext. Trill.]

	Metric	Old form
Trillium, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 3 volumes of alcohol and 1 volume of water as the menstruum.

N. F. Preparation.—Elixir Viburni Opuli Compositum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM VALERIANÆ. N. F. Fluidextract of Valerian
(U.S.P. VIII)

[Fldext. Valer.]

	Metric	Old form
Valerian, in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 4 volumes of alcohol and 1 volume of water as the menstruum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM VERBASCI FOLIÆ. N. F. Fluidextract of Mullein Leaves

[Fldext. Verbasc. Fol.]

	Metric	Old form
Mullein Leaves, in No. 20 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—1 fluidrachm (4 mils).

FLUIDEXTRACTUM VERBENÆ. N. F. Fluidextract of Verbena

[Fldext. Verben.]

	Metric	Old form
Verbena, in No. 30 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—15 minims (1 mil).

FLUIDEXTRACTUM VIBURNI OPULI. N. F. Fluidextract of Viburnum Opulus

[Fldext. Viburn. Opul.]

	Metric	Old form
Viburnum Opulus, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using a mixture of 2 volumes of alcohol and 1 volume of water as the menstruum.

N. F. Preparation.—Elixir Viburni Opuli Compositum.

Average dose.—30 minims (2 mils).

FLUIDEXTRACTUM ZEÆ. N. F. **Fluidextract of Zea**
[Fldext. Zea.]

	Metric	Old form
Zea, finely cut	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 mils**	3 pints

Prepare a Fluidextract by Type Process A (see page 521), using diluted alcohol as the menstruum.

Average dose.—1 fluidrachm (4 mils).

Fluidglycerata *Fluidglycerates*

Fluidglycerates are a new class of preparations designed to avoid the use of alcohol. They are intended to be of the same drug strength as Fluidextracts. They contain approximately 50 per cent., by volume, of glycerin and no alcohol. The drug should be in a No. 20 or No. 30 powder unless otherwise directed. Fluidglycerates made from drugs that do not require either an acid or an alkaline menstruum may be prepared by the following general process:

General Process

	Metric	Old form
The Drug, in coarse powder	**1000 Gm.**	50 oz. av.
Glycerin	**500 mils**	1½ pints
Distilled Water	**1500 mils**	4½ pints
Chloroform Water, a sufficient quantity,		
To make	**1000 mils**	3 pints

Mix the glycerin and distilled water and moisten the drug thoroughly with a portion of the mixture, then pack it very lightly in a cylindrical percolator, and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly until the drug is practically exhausted, using first the remainder of the menstruum and then chloroform water.

Reserve the first 500 mils [old form 1½ pints] of the percolate and evaporate the remainder on a water bath, the weaker portion first, then the stronger, until reduced to 600 mils [old form about 29 fl. oz.]. then add the reserved portion and continue evaporation until the product measures 1000 mils [old form 3 pints]. Allow the preparation to stand for a few days, then decant the clear portion and strain the remainder.

FLUIDGLYCERATUM CASCARÆ SAGRADÆ. N. F. **Fluidglycerate of Cascara Sagrada**
[Fldglycer. Casc. Sagr.]

	Metric	Old form
Cascara Sagrada, in No. 20 powder	**1000 Gm.**	50 oz. av.
Glycerin	**500 mils**	1½ pints
Distilled Water	**1500 mils**	4½ pints
Chloroform Water, a sufficient quantity,		
To make	**1000 mils**	3 pints

Mix the glycerin and distilled water and moisten the drug thoroughly with a portion of the mixture, then pack it very lightly in a cylindrical percolator, and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly until the drug is practically exhausted, using first the remainder of the menstruum and then chloroform water.

Reserve the first 500 mils [old form 1½ pints] of the percolate and evaporate the remainder on a water bath, the weaker portion first, then the stronger, until reduced to 600 mils [old form about 29 fl. oz.], then add the reserved portion and continue evaporation until the product measures 1000 mils [old form 3 pints]. Allow the preparation to stand for a few days, then decant the clear portion and strain the remainder.

Average dose.—15 minims (1 mil).

FLUIDGLYCERATUM CASCARÆ SAGRADÆ AROMATICUM. N. F.

Aromatic Fluidglycerate of Cascara Sagrada

[Fldglycer. Casc. Sagr. Arom.]

	Metric	Old form
Cascara Sagrada, in No. 20 powder	**750 Gm.**	37½ oz. av.
Fluidglycerate of Glycyrrhiza	**250 mils**	12 fl. oz.
Calcium Oxide	**38 Gm.**	1 oz. av. 394 gr.
Glycerin	**375 mils**	18 fl. oz.
Oil of Fennel	**1 mil**	23 min.
Oil of Clove	**1 mil**	23 min.
Oil of Cinnamon	**1 mil**	23 min.
Water, **Chloroform Water,** each, a sufficient quantity,		
To make	**1000 mils**	3 pints

Slake the calcium oxide, mix it with 1500 mils [old form 4½ pints] of water and stir in the cascara sagrada, moistening the drug evenly and thoroughly. Expose the moist powder to a moderate heat until dry. Mix the glycerin with 1125 mils [old form 54 fl. oz.] of water and moisten the cascara sagrada with 600 mils [old form about 29 fl. oz.] of this menstruum, pack it lightly in a cylindrical percolator, and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate the mixture for forty-eight hours. Then allow the percolation to proceed slowly until the drug is practically exhausted, using first the remainder of the menstruum and afterwards chloroform water.

Reserve the first 375 mils [old form 18 fl. oz.] of the percolate and evaporate the remainder on a water bath, the weaker portion first, then the stronger, until it is reduced to 450 mils [old form 21½ fl. oz.], then add the reserved portion and continue the evaporation until the liquid measures 747 mils [old form 35 fl. oz. 411 minims]. When cold add the fluidglycerate of glycyrrhiza and the volatile oils and mix thoroughly. Allow the preparation to stand for a few days, then decant the clear portion and strain the remainder.

N. F. Preparation.—Syrupus Ficorum Compositus.

Average dose.—15 minims (1 mil).

FLUIDGLYCERATUM GLYCYRRHIZÆ. N. F. Fluidglycerate of Glycyrrhiza

[Fldglycer. Glycyrrh. FLUIDGLYCERATE OF LICORICE]

	Metric	Old form
Glycyrrhiza, in No. 20 powder	**1000 Gm.**	50 oz. av.
Ammonia Water	**60 mils**	2 fl. oz. 423 min.
Glycerin	**500 mils**	1½ pints
Distilled Water	**1500 mils**	4½ pints
Chloroform Water, a sufficient quantity,		
To make	**1000 mils**	3 pints

Mix the glycerin and distilled water. Add 50 mils [old form 2 fl. oz. 192 minims] of the ammonia water to 600 mils [old form 28 fl. oz. 384 minims] of this glycerin-water menstruum and moisten the drug thoroughly with a portion of the mixture, then pack it very lightly in a cylindrical percolator, and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly until the drug is practically exhausted, using first the remainder of the menstruum and then chloroform water.

Reserve the first 500 mils [old form 24 fl. oz.] of the percolate and evaporate the remainder on a water bath, the weaker portion first, then the stronger, until reduced to 600 mils [old form about 29 fl. oz.], then add the reserved portion and continue evaporation until the product measures 990 mils [old form 47 fl. oz. 249 minims]. Add the remaining 10 mils [old form 231 minims] of ammonia water to the cold product and mix thoroughly. Allow the preparation to stand for a few days, then decant the clear portion and strain the remainder.

N. F. Preparation.—Fluidglyceratum Cascaræ Sagradæ Aromaticum; Syrupus Glycyrrhizæ

Average dose.—30 minims (2 mils).

FLUIDGLYCERATUM KRAMERIÆ. N. F. Fluidglycerate of Krameria

[Fldglycer. Kramer.]

	Metric	Old form
Krameria, in No. 20 powder	**1000 Gm.**	50 oz. av.
Glycerin	**500 mils**	1½ pints
Distilled Water	**1500 mils**	4½ pints
Chloroform Water, a sufficient quantity,		
To make	**1500 mils**	3 pints

Mix the glycerin and distilled water and moisten the drug thoroughly with a portion of the mixture, then pack it very lightly in a cylindrical percolator, and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly until the drug is practically exhausted, using first the remainder of the menstruum and then chloroform water.

Reserve the first 500 mils [old form 1½ pints] of the percolate and evaporate the remainder on a water bath, the weaker portion first, then the stronger, until reduced to 600 mils [old form about 28½ fl. oz.], then add the reserved portion and continue evaporation until the product measures 1000 mils [old form 3 pints]. Allow the preparation to stand for a few days, then decant the clear portion and strain the remainder.

Average dose.—15 minims (1 mil).

FLUIDGLYCERATUM RHEI. N. F. **Fluidglycerate of Rhubarb**
[Fldglycer. Rhei]

	Metric	Old form
Rhubarb, in No. 20 powder	**1000 Gm.**	50 oz. av.
Glycerin	**500 mils**	1¼ pints
Distilled Water	**1500 mils**	4½ pints
Chloroform Water, a sufficient quantity,		
To make	**1000 mils**	3 pints

Mix the glycerin and distilled water and moisten the drug thoroughly with a portion of the mixture, then pack it very lightly in a cylindrical percolator, and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly until the drug is practically exhausted, using first the remainder of the menstruum and then chloroform water.

Reserve the first 500 mils [old form 1½ pints] of the percolate and evaporate the remainder on a water bath, the weaker portion first, then the stronger, until reduced to 600 mils [old from about 28½ fl. oz.], then add the reserved portion and continue the evaporation until the product measures 1000 mils [old form 3 pints]. Allow the preparation to stand for a few days, then decant the clear portion and strain the remainder.

Average dose.—15 minims (1 mil).

QUESTIONS ON ALCOHOLIC LIQUIDS MADE BY PERCOLATION OR MACERATION

What are tinctures? How many are official in the U. S. P.? How many in the N. F.? (See page 461.)
Wherein do they differ from spirits?
What exception is there to this rule?
What menstrua are used in making tinctures?
What are the advantages, and what the disadvantages, of using alcohol as a menstruum?
Where the alcohol is objectionable, what other preparation may be substituted for a tincture?
Which will extract a larger amount of the soluble principles of a drug, a pint of diluted alcohol or half a pint of alcohol and half a pint of water, used separately?
Name some of the principal substances that are soluble in alcohol.
What substances are soluble in diluted alcohol?
For what purpose is glycerin used in tinctures?
In what different ways are official tinctures made?
Which is the best method for making tinctures?
What are the special advantages of percolation?

Which will be found more convenient in practice, the use of measures or the use of parts by weight in making tinctures?
In what cases is the process of maceration preferably used?
What tincture is made by simple solution?
What U. S. P. tincture is made by dilution?
What standard of strength was adopted for potent tinctures by the International Conference at Brussels and afterwards by the U. S. P.?
What is the usual strength of tinctures in the U. S. P. for those which are not considered powerful in action?
Name any official exception in strength to those in these two classes. Which U. S. P. tinctures are assayed?
Outline briefly the U. S. P. type process for preparing tinctures by percolation. For making them by maceration.
How is Type Process P modified when the tincture is to be assayed?
Give the formula and process for making tincture of aconite.
What is the drug strength of tincture of aconite? What was the U. S. P. 1890 strength?
What amount of ether-soluble alkaloids of aconite should be present in 100 mils of tincture? State the biological standard adopted by the U. S. P. IX for tincture of aconite.
What part of the plant is meant by aconite?
What fineness of powder is used in this formula?
Give the official name, formula, and process for making tincture of aloes. Tincture of arnica.
Give the official name, formula, and process for making tincture of asafetida. Tincture of bitter orange peel. Tincture of sweet orange peel. Tincture of belladonna leaves. (What amount of alkaloids should be present in 100 mils of tincture of belladonna leaves?) Tincture of benzoin. Compound tincture of benzoin. Tincture of calumba. Tincture of cannabis. (What biological standard is required for tincture of cannabis?) Tincture of cantharides. Tincture of capsicum. Tincture of cardamom. Compound tincture of cardamom. Tincture of cinchona. What kind of cinchona is used in this tincture?
What alkaloidal strength is required for tincture of cinchona?
Give the formula and process for making compound tincture of cinchona.
What kind of cinchona is used in this tincture?
What degree of fineness is directed for the powder? What is its alkaloidal standard?
Give the formula and mode of making tincture of cinnamon. Tincture of colchicum seed. (How much colchicine should be present in 100 mils of tincture of colchicum seed?) Tincture of digitalis. Give the biological standard adopted for tincture of digitalis.
Give the formula for tincture of ferric chloride. What salt of iron does it contain?
Give the formula and mode of making compound tincture of gambir. What is its synonym? Tincture of gelsemium. Compound tincture of gentian.
Give the formula and process for making tincture of guaiac. Ammoniated tincture of guaiac. What degree of fineness is directed for the powder in these last two tinctures? Tincture of hydrastis. (What amount of the ether-soluble alkaloid of hydrastis should be contained in 100 mils of the tincture?) Tincture of hyoscyamus. (What amount of the alkaloids of hyoscyamus should be present in 100 mils of tincture?)
Give the formula and process for making tincture of iodine.
Why has water been added to this formula?
Give the formula and mode of making tincture of kino. Tincture of lactucarium. (Why is tincture of lactucarium first treated with purified petroleum benzin?) Compound tincture of lavender.
What is the strength of tincture of lemon peel? What precautions must be taken in preparing the lemon peel?
Give the formula and process for making tincture of lobelia.
What part of the plant is meant by lobelia?
Give the formula and process for making tincture of musk. Tincture of myrrh. Tincture of nux vomica. How much of the total alkaloids of nux vomica should each 100 mils of tincture contain?
How is tincture of opium made?
How much opium is there in each 100 mils of tincture?
About how much is there in a teaspoonful of tincture?

How much anhydrous morphine should be present in 100 mils of tincture?
Give the formula and process for making camphorated tincture of opium.
How much opium is there in each 100 mils of this tincture? How much in a teaspoonful?
How is tincture of deodorized opium made?
How much opium is there in each 100 mils of the tincture?
Give the formula and process for making tincture of physostigma. (What amount of alkaloid of physostigma should be present in 100 mils of the tincture?) Tincture of pyrethrum. Tincture of quassia. Tincture of rhubarb. Aromatic tincture of rhubarb. Tincture of sanguinaria. Tincture of squill. Tincture of stramonium. (State the amount of alkaloids which should be present in 100 mils of tincture of stramonium.) Tincture of strophanthus. What is the strength of this tincture and what was its strength in the U. S. P. 1890? What is the dose? Why is it extracted with benzin in the preliminary treatment? Give the biological standard adopted for this tincture. Tincture of tolu. Tincture of valerian. Ammoniated tincture of valerian. Tincture of veratrum viride. Tincture of ginger. (How may the absence of capsicum or other pungent substitutes be detected if present in this tincture?)
Why is the per cent. of alcohol specially mentioned?
How are ethereal tinctures made? Of what strength? How are tinctures of fresh drugs to be made if no specific directions are given?
Name the ingredients in tincture of aloes and myrrh. In bitter tincture. How is Warburg's tincture made? Name the ingredients. The ingredients in aromatic tincture.
What is the strength of tincture of cactus grandiflorus? What kind of drug must be used in this preparation?
Give the method for making the following and indicate their strength: Tincture of calendula. Tincture of capsicum and myrrh. What are its synonyms? Tincture of caramel. Tincture of cimicifuga. Tincture of cocculus indicus. Tincture of saffron. Tincture of cubeb. Tincture of larkspur. Ammoniated tincture of ergot. Ethereal tincture of ferric chloride. What are the synonyms? Tincture of ferric citro-chloride. In what preparations is this tincture used? Why is it allowed to stand for several days before filtering?
How are the following prepared: Tincture of ferrated extract of apples? What iron salt is present in this tincture? Tincture of nutgall? Compound tincture of guaiac? Tincture of hops? Tincture of ignatia? What amount of alkaloid must be present in this tincture? How much iodine in stronger tincture of iodine? What is its synonym?
How is decolorized tincture of iodine made? Tincture of ipecac and opium? What is its synonym? Give the method for making the following and state their strength: Tincture of jalap. Compound tincture of jalap. Compound tincture of kino and opium. Tincture of krameria. Tincture of opium with saffron. What is its morphine standard? What is its synonym and P. I. title?
Give the strength and method for preparing the following: Tincture of Paracoto. What was the N. F. III title? Tincture of passion flower. Pectoral tincture. How much opium is present in one fluidounce of this tincture? What are its synonyms? Tincture of cudbear. Compound tincture of cudbear. Tincture of pimpinella. Tincture of pulsatilla. Tincture of quillaja. Aqueous tincture of rhubarb. Sweet tincture of rhubarb. Tincture of rhubarb and gentian. Tincture of saw palmetto and santal. Tincture of serpentaria. Tincture of sumbul. Tincture of vanilla. Compound tincture of viburnum. Bitter tincture of zedoary.
What are medicated wines?
Which are preferable preparations, wines or tinctures? and why?
Why were wines not recognized by the U. S. P. IX?
Name the wines official in the N. F. IV?
In how many different ways are wines prepared?
Which one is not medicated?
How many are made by solution? Name them.
Name those made by maceration. By percolation.
What is sherry wine? What percentage of alcohol should it contain?
Give the formula and process for making wine of antimony.
What percentage of antimony and potassium tartrate does it contain?
About how much in the official average dose?

Give the formula and process for making compound wine of orange. Wine of beef. Wine of beef and iron. Wine of colchicum corm. Wine of colchicum seed. Wine of iron. Bitter wine of iron. Wine of white ash. Wine of ipecac. (What alkaloidal strength is required?) Wine of pepsin. Wine of tar. Wine of wild cherry. Ferrated wine of wild cherry. Compound wine of rhubarb.

What are fluidextracts?

When were they made official in the U. S. P. for the first time?

How many are there in the present Pharmacopœia? In the N. F.?

What are the special advantages of fluidextracts? How is permanency secured?

What is the advantage of concentration?

How many fluidextracts of the U. S. P. IX are standardized? How many of the N. F. IV? Name them.

By what different methods are fluidextracts made?

Name the type processes for fluidextracts recognized by the U. S. P. and N. F.

Explain in detail the official methods involving percolation and partial evaporation.

Explain the process of percolation with incomplete exhaustion in making fluidextracts. What is the principal disadvantage of this process, and why are the official processes better?

Give a description of the process of repercolation. Outline the official process involving this principle. What is "continuous percolation"? Of vacuum maceration and percolation.

Which official fluidextracts may be prepared by hot water extraction, evaporation and preservation? Outline the details of this process.

How may fluidextracts be best preserved?

What are "fluidacetracts"? What advantages have this class of preparations?

Give the alkaloidal strength adopted for the following fluidextracts: aconite, belladonna root, cinchona, colchicum seed, guarana, hydrastis, hyoscyamus, ipecac, nux vomica, pilocarpus, aqueous fluidextract of cinchona, colchicum corm conium, and stramonium.

Give the biological standard adopted for the following fluidextracts: Aconite, cannabis, digitalis, squill, apocynum.

Name the official fluidextracts made by extraction with boiling water, evaporation and preservation with alcohol.

Why is type process C (fractional percolation) adopted for fluidextract of aconite, for aromatic fluidextract and fluidextract of bitter orange?

Why is the drug in aromatic fluidextract of cascara sagrada, treated with magnesium oxide?

What are fluidglycerates?

Outline the general process for making fluidglycerates. Name those official in the N. F.

CHAPTER XXVIII

OLEORESINOUS LIQUIDS MADE BY PERCOLATION, ETC.

Oleoresinæ *Oleoresins*

THE oleoresins are liquid preparations, consisting principally of natural oils and resins extracted from vegetable substances by percolation with acetone or ether. The latter had been used in the Pharmacopœia for many years for this purpose, but was replaced by acetone in the U. S. P. VIII, because this menstruum was found to be less inflammable and not so expensive, the oleoresin of cubeb being an exception, its menstruum being alcohol. Ether, however, has again replaced acetone as the menstruum for the oleoresins of the U. S. P. IX, as its cost has been greatly reduced, due to the manufacturers now being permitted, by the U. S. Government, to make ether from a specially denatured ethyl alcohol. The Oleoresin of Cubeb is an exception, however, being made with alcohol as the menstruum. The oleoresins were formerly classed with fluidextracts, but they differ essentially from the latter: 1. They do not bear a uniform relation to the drug as do the fluidextracts, of gramme to mil, and the yield of oleoresin obtained from the drug varies according to the proportion of oil and resin naturally present. 2. The menstruum (ether) extracts principles which are often insoluble in alcohol, diluted alcohol or water. 3. They are without exception the most concentrated liquid preparations of the drugs that are produced.

FIG. 439

Percolator for volatile liquids

Oleoresins are prepared by percolating the powdered drug contained in a cylindrical percolator provided with a cover and receptacle suitable for volatile liquids, with ether, acetone, or alcohol, until exhausted, recovering the greater part of the liquid by distillation, and exposing the residue in a shallow dish to spontaneous evaporation until the remaining solvent has evaporated. Fig. 439 shows a convenient percolator for making oleoresins. The powder should not be packed too tightly in the narrow percolator; the exit tube affords a means of easily regulating the flow. A *continuous extraction apparatus* can be made of this percolator by enclosing the upper part in a suitable case and passing cold water between, arranging the apparatus like a Liebig's condenser (see page 169). A glass tube is connected with the top of the percolator and the mouth of the bottle by rubber tube connections, and if the receiving bottle is placed in a water bath and the water gently heated the ether will evaporate from the percolate, and the vapors, rising in the tube, will condense in the upper part of the percolator.

A form of continuous extraction apparatus frequently used for the hot extraction of drugs with volatile solvents is termed a Soxhlet apparatus.

Oleoresins which have not been evaporated sufficiently are frequently found in commerce; they have a decided odor of the menstruum, some-

times of benzin, showing in the latter case that a menstruum which is an inferior solvent has been substituted for the one authorized by the Pharmacopœia. Commercial gasoline often contains appreciable quantities of kerosene, which would not volatilize but permanently contaminate the oleoresins. It should never be used as the solvent for oleoresins. *Six* oleoresins are official in the U. S. P. IX and *one* in the N. F. IV.

Table of Official Oleoresins

Name	Yield	Average Dose
Oleoresina Aspidii, U. S. P. IX	10 to 15 per cent.	30 grains (2 Gm.) single dose, once a day—Caution
Capsici, U. S. P. IX.	About 5 per cent.	½ grain (0.03 Gm.)
Cubebæ, U. S. P. IX	18 to 25 per cent.	8 grains (0.5 Gm.)
Lupulini, N. F. IV	About 50 per cent.	3 grains (0.2 mils)
Petroselini, U. S. P. IX	About 5 per cent. but variable	*M* viii (0.5 mil)
Piperis, U. S. P. IX	About 5 per cent.	½ grain (0.03 Gm.)
Zingiberis, U. S. P. IX	6 to 8 per cent.	½ grain (0.03 Gm.)

OLEORESINA ASPIDII. U. S. Oleoresin of Aspidium

[Oleores. Aspid. Oleoresin of Male Fern]

	Metric	Old form
Aspidium, recently reduced to No. 40 powder.....	**500 Gm.**	16 oz. av.
Ether, a sufficient quantity.		

Place the aspidium in a cylindrical glass percolator, provided with a stop-cock, and arranged with a cover and a receptacle suitable for volatile liquids. Pack the powder firmly, and percolate slowly with ether, added in successive portions, until the drug is exhausted. Recover the greater part of the ether from the percolate by distillation on a water bath, and, having transferred the residue to a dish, allow the remaining ether to evaporate spontaneously in a warm place. Keep the Oleoresin in a well-stoppered bottle.

Note.—Oleoresin of Aspidium, on standing, usually deposits a granular, crystalline substance. This should be thoroughly mixed with the liquid portion before use.

Average dose.—Caution! Single dose, once a day, 30 grains (2 Gm.).

OLEORESINA CAPSICI. U. S. Oleoresin of Capsicum

[Oleores. Capsic.]

	Metric	Old form
Capsicum, in No. 40 powder.....	**500 Gm.**	32 oz. av.
Ether, a sufficient quantity.		

Place the capsicum in a cylindrical glass percolator, provided with a stop-cock, and arranged with a cover and a receptacle suitable for volatile liquids. Pack the powder firmly, and percolate slowly with ether, added in successive portions, until the percolate measures 800 mils [old form about 3 pints]. Recover the greater part of the ether from the percolate by distillation on a water bath, and, having transferred the residue to a dish, allow the remaining ether to evaporate spontaneously in a warm place. Then pour off the liquid portion, transfer the remainder to a glass funnel provided with a pledget of cotton, and, when the

separated fatty matter (which is to be rejected) has been completely drained, mix the liquid portions together. Keep the Oleoresin in a well-stoppered bottle.

U. S. P. Preparation.—Emplastrum Capsici.

Average dose.—½ grain (0.03 Gm.)

OLEORESINA CUBEBÆ. U. S. Oleoresin of Cubeb
[Oleores. Cubeb.]

	Metric	Old form
Cubeb, in No. 30 powder	**500 Gm.**	16 oz. av.
Alcohol, a sufficient quantity.		

Place the cubeb in a cylindrical glass percolator, pack the powder firmly, and percolate slowly with alcohol, added in successive portions, until the drug is exhausted. Recover the greater part of the alcohol from the percolate by distillation on a water bath, and, having transferred the residue to a dish, allow the remaining alcohol to evaporate, in a warm place, stirring frequently. Keep the Oleoresin in a well-stoppered bottle.

NOTE.—Oleoresin of Cubeb, after standing for some time, deposits a waxy and crystalline precipitate, which should be rejected, the liquid portion only being used.

U. S. P. Preparation.—Trochisci Cubebæ.

Average dose.—8 grains (0.5 Gm.).

OLEORESINA LUPULINI. N. F. Oleoresin of Lupulin
(U.S.P. VIII)
[Oleores. Lupulin.]

	Metric	Old form
Lupulin	**500 Gm.**	16 oz. av.
Ether, a sufficient quantity.		

Introduce the lupulin into a cylindrical glass percolator, provided with a stop-cock, and arranged with a cover and a receptacle suitable for volatile liquids. Press the powder very lightly, and percolate slowly with ether, added in successive portions, until the lupulin is practically exhausted. Recover the greater part of the ether from the percolate by distillation on a water bath, and, having transferred the residue to a dish, allow the remaining ether to evaporate spontaneously in a warm place. Preserve the oleoresin in a well-stoppered bottle.

Average dose.—3 grains (0.2 mil).

OLEORESINA PETROSELINI. U. S. Oleoresin of Parsley Fruit
[Oleores. Petrosel. LIQUID APIOL]

	Metric	Old form
Parsley Fruit, in No. 60 powder	**500 Gm.**	16 oz. av.
Ether, a sufficient quantity.		

Place the parsley fruit in a cylindrical glass percolator, provided with a stop-cock, and arranged with a cover and a receptacle suitable for volatile liquids. Pack the powder firmly, and percolate slowly with ether, added in successive portions until the drug is exhausted. Recover

the greater portion of the ether by distillation on a water bath, and, having transferred the residue to a dish, remove the remaining ether by spontaneous evaporation in a warm place, stirring frequently. Allow the Oleoresin to stand without agitation for four or five days, decant the clear liquid portion from any solid residue, and preserve it in well-stoppered bottles.

Average dose.—8 minims (0.5 mil).

OLEORESINA PIPERIS. U. S. Oleoresin of Pepper
[Oleores. Piper.]

	Metric	Old form
Pepper, in No. 40 powder	**500 Gm.**	32 oz. av.
Ether, a sufficient quantity.		

Place the pepper in a cylindrical glass percolator, provided with a stop-cock, and arranged with a cover and a receptacle for volatile liquids. Pack the powder firmly, and percolate slowly with ether, added in successive portions, until the drug is exhausted. Recover the greater part of the ether from the percolate by distillation on a water bath, and, having transferred the residue to a dish, set this aside in a warm place until the remaining ether has evaporated and the deposition of piperine has ceased. Lastly, separate the Oleoresin from the piperine by straining through purified cotton. Keep the Oleoresin in a well-stoppered bottle.

Average dose.—½ grain (0.03 Gm.).

OLEORESINA ZINGIBERIS. U. S. Oleoresin of Ginger
[Oleores. Zingib.]

	Metric	Old form
Ginger, in No. 60 powder	**500 Gm.**	16 oz. av.
Ether, a sufficient quantity.		

Place the ginger in a cylindrical glass percolator, provided with a stop-cock, and arranged with a cover and a receptacle suitable for volatile liquids. Pack the powder firmly, and percolate slowly with ether, added in successive portions, until the drug is exhausted. Recover the greater part of the ether from the percolate by distillation on a water bath, and, having transferred the residue to a dish, allow the remaining ether to evaporate spontaneously in a warm place. Keep the Oleoresin in a well-stoppered bottle.

Average dose.—½ grain (0.03 Gm.).

Oleæ Infusæ *Infused Oils*

The character of this class of preparations is well illustrated by the General Formula given below. They consist of a solution in oil of the soluble constitutents of plants, chiefly of those containing alkaloids or volatile oils, such as hyoscyamus, belladonna, calendula, etc. The Compound Oil of Hyoscyamus closely resembles the *Baume Tranquille* of the French Pharmacopœia and is extensively used for earache.

OLEA INFUSA. N. F. Infused Oils

[Ol. Inf.]

	Metric	Old form
The Air Dried Drug, in No. 30 powder	**100 Gm.**	3 oz. av. 88 gr.
Alcohol	**100 mils**	3 fl. oz. 88 min.
Ammonia Water	**2 mils**	28 min.
Sesame Oil	**1000 Gm.**	32 oz. av.
To make about	**1000 Gm.**	32 oz. av.

Moisten the drug with the alcohol and ammonia water, previously mixed, macerate for six hours in a covered vessel, and then add the sesame oil. Warm this mixture on a water bath, at a temperature between 60° and 70° C. (140° and 158° F.) in an open vessel, frequently stirring, until the alcohol and ammonia water are dissipated. Then transfer the mixture to a strainer, express the residue and filter the strained Oil.

Preserve Infused Oils in small, amber-colored bottles in a cool place.

N. F. Preparation.—Oleum Hyoscyamus Compositum.

OLEUM HYOSCYAMI COMPOSITUM. N. F. Compound Oil of Hyoscyamus

[Ol. Hyosc. Co. Balsamum Tranquillans]

	Metric	Old form
Oil of Lavender	**2 mils**	31 min.
Oil of Peppermint	**2 mils**	31 min.
Oil of Rosemary	**2 mils**	31 min.
Oil of Thyme	**2 mils**	31 min.
Infused Oil of Hyoscyamus,[1] a sufficient quantity,		
To make	**1000 mils**	2 pints

Mix them.

[1] The Infused Oil of Hyoscyamus is prepared by the general formula for Infused Oils (see above).

CHAPTER XXIX

ACETOUS LIQUIDS MADE BY PERCOLATION

Aceta *Vinegars*

THIS class of preparations is an old one, having been in use since the days of Hippocrates. Medicated vinegars are solutions of the active principles of drugs in diluted acetic acid, the latter being chosen as a menstruum because acetic acid is not only a good solvent but also possesses antiseptic properties.

Diluted acetic acid replaces the menstrua formerly used, wine and cider vinegars having been discarded on account of their variable quality. Acetic acid may be obtained in all parts of the country very cheaply and of unexceptionable quality, and by simple admixture with about five times its weight of water the menstruum is produced. The properties of acetic acid are noticed in Part IV of this work.

Only *one* vinegar is official at present in the U. S. P. IX and *two* in the N. F. IV. The advantage of using acidulous menstruum is apparent in forming soluble salts with most of the active principles of drugs, and experience has proved the value of diluted acetic acid as a solvent in exhausting drugs. The medicated vinegars should not be made in larger quantities than can be used within a reasonable time, for, although possessed of most of the characters of permanent preparations, they are liable to deposit upon standing.

Two of the official vinegars are uniform in strength (10 per cent.). They are all made by maceration.

Official U. S. P. and N. F. Vinegars

Title	Ingredients	Method of Preparation
Acetum Aromaticum, N.F.IV.	0.5 mil each of the Oils of Lavender, Rosemary, Juniper, Peppermint, and Cinnamon; 1 mil each of the Oils of Lemon and Clove; 250 mils Alcohol; 260 mils Acetic Acid; Water, enough to make 1000 mils	Dissolve the Oils in the Alcohol, add the Acetic Acid and enough Water to make 1000 mils. Filter after standing 8 days
Opii, N.F.IV.	100 Gm. Granulated Opium; 30 Gm. Powdered Myristica; 200 Gm. Sugar; enough Diluted Acetic Acid to make 1000 mils	Macerate the drugs in 500 mils of Diluted Acetic Acid during 7 days, transfer to a percolator and add enough Diluted Acetic Acid to make 1000 mils of percolate
Scillæ U.S.P. IX.	100 Gm. Squill, No. 20 powder; enough Diluted Acetic Acid to make 1000 mils	Macerate the drug with 900 mils of Diluted Acetic Acid during 7 days, strain, heat to boiling, filter, and add enough Diluted Acetic Acid to make 1000 mils

Unofficial Vinegars

Title	Ingredients	Method of Preparation
Acetum Cantharidini Br.	1 Gm. Cantharidin, 200 mils Glacial Acetic Acid; Acetic Acid, enough to make 2000 mils	Dissolve the Cantharidin in the Glacial Acetic Acid on a water bath and add enough Acetic Acid to make 2000 mils
Urgineæ Br. (Indian Squill)	1000 Gm. bruised Urginea; 1000 mils Acetic Acid; 3200 mils Distilled Water	Macerate for 7 days and filter

ACETUM AROMATICUM. N. F. Aromatic Vinegar
[Acet. Arom.]

	Metric	Old form
Oil of Lavender	**0.5 mil**	8 min.
Oil of Rosemary	**0.5 mil**	8 min.
Oil of Juniper	**0.5 mil**	8 min.
Oil of Peppermint	**0.5 mil**	8 min.
Oil of Cinnamon	**0.5 mil**	8 min.
Oil of Lemon	**1.0 mil**	15 min.
Oil of Clove	**1.0 mil**	15 min.
Alcohol	**250.0 mils**	8 fl. oz.
Acetic Acid	**260.0 mils**	8 fl. oz. 154 min.
Water, a sufficient quantity,		
To make	**1000 mils**	2 pints

Dissolve the oils in the alcohol, add the acetic acid, and lastly enough water to make the product measure 1000 mils [old form 2 pints]. Set the mixture aside for eight days, occasionally agitating it, and then filter.

ACETUM OPII. N. F. Vinegar of Opium
(U.S.P. VIII)
[Acet. Opii]

	Metric	Old form
Granulated Opium	**100 Gm.**	3 oz. av. 148 gr.
Myristica, in No. 30 powder	**30 Gm.**	1 oz. av.
Sugar	**200 Gm.**	6 oz. av. 296 gr.
Diluted Acetic Acid, a sufficient quantity,		
To make	**1000 Gm.**	2 pints

Macerate the opium, myristica and sugar in 500 mils [old form 1 pint] of diluted acetic acid during seven days, frequently shaking the mixture; then transfer it to a cylindrical percolator in the neck of which has been placed a pledget of purified cotton. Allow the percolation to proceed slowly until the liquid has entirely disappeared from the surface, then gradually pour on diluted acetic acid and continue the percolation until the product measures 1000 mils [old form 2 pints].

Average dose.—8 minims (0.5 mil).

ACETUM SCILLÆ. U. S. Vinegar of Squill
[Acet. Scill.]

	Metric	Old form
Squill, in No. 20 powder	**100 Gm.**	3 oz. av. 148 gr.
Diluted Acetic Acid, a sufficient quantity,		
To make	**1000 mils**	2 pints

Macerate the squill with 900 mils [old form about 29 fl. oz.] of diluted acetic acid during seven days with frequent agitation; then strain the mixture, and wash the mass on the strainer with enough diluted acetic acid to make the strained liquid measure nearly 1000 mils [old form 2 pints]. Heat this liquid to boiling, filter while hot, and when cold add sufficient diluted acetic acid to make the product measure 1000 mils [old form 2 pints].

U. S. P. Preparation.—Syrupus Scillæ.
N. F. Preparation.—Oxymel Scillæ.

Average dose—15 minims, (1 mil).

QUESTIONS ON OLEORESINOUS, OILY AND ACETOUS LIQUIDS MADE BY PERCOLATION OR MACERATION

What are oleoresins? (See page 598.)
In what respects do they differ from fluidextracts?
How are they prepared?
How many oleoresins are official? Name them.
Why should commercial gasoline not be used as a solvent for oleoresins?
Give the official name, menstruum, and process for preparing oleoresin of aspidium.
Should the deposit which usually occurs in this oleoresin upon standing be filtered out?
Give the Latin name, menstruum, and process for preparing oleoresin of capsicum. Oleoresin of cubeb.
Should the waxy and crystalline matter which is deposited from oleoresin of cubeb be separated from the oleoresin?
Give the Latin name, menstruum, and process for preparing oleoresin of lupulin. Oleoresin of parsley fruit. What is the synonym of the latter? Oleoresin of pepper.
Should the latter oleoresin be separated from the piperine which is deposited?
Give the Latin name, menstruum, and process for preparing oleoresin of ginger.
What are infused oils?
What class of drugs are mainly employed in their preparation.
Outline the general formula.
Name the ingredients in compound oil of hyoscyamus. What is its synonym?
What are medicated vinegars? (See page 603.)
Why was vinegar chosen as a menstruum, and why is acetic acid now used in place of vinegar?
How many vinegars are official in the U. S. P. IX? How many in the N. F. IV? Name them.
What is their percentage strength?
How are they made?
Give the Latin name and menstruum of vinegar of squill.
What are the ingredients of aromatic vinegar? Of vinegar of opium? What per cent. of opium is present?

CHAPTER XXX

SOLID PREPARATIONS MADE BY PERCOLATION

Extracta *Extracts*

Extracts are solid or semi-solid preparations produced by evaporating solutions of vegetable principles. The solutions may be made by percolating the drug with water, alcohol, diluted alcohol of various strengths, ether, diluted acetic acid, or diluted solution of ammonia, and the extracts made from such percolates are termed respectively *aqueous*, *alcoholic*, *hydro-alcoholic*, *ethereal*, *acetic*, or *ammoniated* extracts. In addition to this, the juices of fresh plants extracted by contusion and expression are evaporated, and such extracts are frequently called *Succi spissati*, or *inspissated juices*.

Preparation of Inspissated Juices.—The variation in the amount of extractive matter afforded by expressing fresh plants is so great that the quality of this class of extracts is necessarily very uncertain. Although alcoholic extracts are also subject to variations, experience has shown that they are much more reliable, when properly made, than extracts prepared from expressed juices. For this reason inspissated juices were not recognized in the U. S. Pharmacopœia. The inspissated juices most largely consumed in America are made in Great Britain, and the general formula of the British Pharmacopœia of 1898 is appended:

"Bruise the fresh plant in a mortar, press out the juice, and heat it gradually to 130° F., and separate the green colouring matter by a calico filter. Heat the strained liquid to 200° F. (to coagulate the albumen) and filter again. Evaporate the filtrate by a water-bath to the consistence of a thin syrup; add to it the green colouring matter previously separated and passed through a hair-sieve, stir the whole together, and evaporate at a temperature not exceeding 140° F. to the consistence of a soft extract. Two extracts from fresh plants or parts of plants are official in the 1914 British Pharmacopœia, as follows: extract of colchicum, and extract of taraxacum. In the British Pharmacopœia 1898 *two* additional extracts of this character were official, namely, green extract of belladonna and green extract of hyoscyamus."

Prof. Herrara has proposed a plan of making extracts without the use of much heat,—*by freezing the juices*. He finds that by compressing the frozen juice the expressed liquid, or mother-liquor, is greatly strengthened, the water being largely removed as ice, which remains in the press-cloth, and the concentrated juice is then dried by exposure on plates to the sun.

The percolates, or expressed juices of drugs, contain, in addition to the active principles, certain inert substances, which exist in the liquids in varying quantities. The amount of inert matter found in the extract depends largely upon the manipulation, but the composition of extracts also varies with the nature of the drug, the character of the solvent, and the mode of preparation. The object is generally to obtain as much

of the active principle of the plant, with as little of the inert matter, as possible; though sometimes it may be desirable to separate two active ingredients from each other, when their effects upon the system are materially different; this may be partially accomplished by employing a menstruum which, while it dissolves one, leaves the other untouched. The proximate principles most commonly present in extracts are *gum*, *sugar*, *starch*, *tannin*, *extractive*, *chlorophyl*, *coloring-matter*, *salts*, and the *peculiar principles of plants;* to which, when a spirituous solvent is employed, may usually be added, *resinous substances*, *fatty matter*, and frequently more or less *volatile oil*, gum and starch being excluded when the menstruum is strong alcohol. Inert fixed oil or fat is often removed from powdered drugs by previous percolation with ether or petroleum benzin; these liquids do not, as a rule, extract the active principles, and thus a dry powdered extract can be made.

Extractive.—It has long been known that in most vegetable bodies there is a substance, soluble both in water and in alcohol, which, in the preparation of extracts, undergoes chemical change during the process of evaporation, imparting to the liquid, even if originally limpid, first, a greenish, then a yellowish-brown, and ultimately a deep brown color, and becoming itself insoluble. This substance has received the appropriate name of *extractive*, derived from its frequent presence in extracts. Its existence as a distinct principle is denied, or at least doubted, by some chemists, who consider the phenomena supposed to result from its presence as depending upon the mutual reaction of other principles. The most important property of extractive is its disposition to pass, by the influence of atmospheric air at a high temperature, into an insoluble substance. If a vegetable infusion or decoction is evaporated in the open air to the consistence of an extract, then diluted, filtered, and again evaporated, and the process repeated so long as any insoluble matter is formed, the whole of the extractive will be separated from the liquid, while the other ingredients may remain. If chlorine is passed through an infusion or decoction, a similar precipitate is formed with much greater rapidity. The change is usually ascribed to the absorption of oxygen by the extractive, which has, therefore, been called, in its altered condition, oxidized extractive; but De Saussure ascertained that, though oxygen is absorbed during the process, an equal measure of carbonic acid gas is given out, and the oxygen and hydrogen of the extractive unite to form water in such a manner as to leave the principle richer in carbon than it was originally. The name of oxidized extractive is, therefore, obviously incorrect; and Berzelius long ago proposed to substitute for it that of *apothem*, synonymous with deposit. According to Berzelius, apothem is not completely insoluble in water, but imparts a slight color to that liquid when cold, and is rather more soluble in boiling water, which becomes turbid upon cooling. It is still more soluble in alcohol, and is freely dissolved by solutions of the alkalies and alkaline carbonates, from which it is precipitated by acids. It has a great tendency, when precipitated from solutions, to unite with other principles and to carry them along with it, thus acquiring properties somewhat different according to the source from which it is obtained. In this way, also, even when the extractive of a plant is itself medicinally inert, its conversion into apothem may be injurious by causing a precipitation of a portion of the active prin-

ciple; and in practical pharmaceutical operations this change should always, if possible, be avoided.

Variable Quality of Extracts.—*It is evident that there must be great variation in the quality of extracts of pilular consistence as found in commerce,* for, whether made by any of the processes commonly employed, or by a special patented process, the lack of a fixed standard to determine the amount of moisture which is to remain in pilular extracts renders them very variable in strength. The Pharmacopœia is necessarily compelled to avoid specifying an exact limit in this respect, and the approximate standard of "*pilular consistence*" has been adopted. The powdered extracts are more stable and, being adjusted through the addition of a diluent to an exact weight, they have a great advantage over pilular extracts. It should be said in addition that the variation in the strength of extracts of pilular consistence does not cease even after their manufacture. The exposure to the air to which they are subjected in dispensing, particularly if kept in the customary open queen's-ware or glass jars, causes loss of moisture, and they become hard, and consequently stronger, in proportion to the quantity of moisture that is thus lost; this loss may in some cases amount to as much as 25 per cent. In moist climates, however, some extracts absorb moisture and become thinner. One of the advantages of powdered extracts is that they may be kept in tightly corked vials, and thus protected from moisture. The greatest variation in the commercial extracts, however, arises from the difference in the alcoholic strength of the menstruum employed. This may be best illustrated by taking the case of extract of jalap. Here alcohol dissolves the active principles, while water is the best solvent for those that are inert. If a manufacturer in making extract of jalap uses equal parts of alcohol and water, he will obtain twice as much extract as the manufacturer who simply uses alcohol; but the alcohol extract or resin has twice the strength of the hydro-alcoholic extract, and is worth double the price, because it has been shown that the aqueous extract of jalap is absolutely inert even in doses of two hundred and forty grains. The difference between the relative merits of alcoholic and aqueous extracts does not so clearly appear in many of the extracts as in the instance just noted, but it is shown in such important extracts as those from belladonna, hyoscyamus, digitalis, etc., for here the strength depends largely upon the menstrua used in exhausting them, water removing the inert principles, starch, gum, albumen, sugar, salt, etc. The relative value of commercial extracts must depend upon the amount of *active* principles present; and as the manufacturer never states upon the label the menstruum that he has employed in making the extract, nor the yield of the extract from the drug from which it is prepared, and as manufacturers often use menstrua other than that directed by the official standards, the pharmacist and physician have no means of knowing the dose of the extract, nor can they usually form any correct judgment of its value without a therapeutical experiment or analytical assay. It will be seen, therefore, from the foregoing considerations that extracts, except those which are assayed, are among the most *unreliable* of all classes of preparations. It is greatly to be regretted that manufacturers do not more *strictly adhere* to the menstrua directed in the Pharmacopœia, for the sake of securing uniformity, if for no other reason.

Preparation of Extracts.—The manipulations necessary to produce extracts have been considered under the various heads of Maceration, Expression, Percolation, Decoction, Infusion, Evaporation, Use of Steam Heat, Vacuum Apparatus, etc. The special precautions necessary for each extract will be noticed in the official working formulas which follow. The details of the formulas vary so much that a general formula is of little value, except to serve as a type for the alcoholic extracts, which resemble one another more closely than do any of the others.

Preservation of Pilular Extracts.—Special care in the preservation of soft extracts is rarely taken. This arises from the incorrect impression that they are permanent preparations and do not need it. The manufacturers seal the jars or bottles which contain them, because experience has compelled them to be very careful about this, to avoid loss in transportation,—in the case of soft extracts, through inversion of the jar. The loosely fitting covers often used for the jars permit exposure which causes the variation above noticed, and it is impracticable for the pharmacist on every occasion to seal the jar immediately after he has used a portion of the extract. Several expedients have been suggested to overcome these difficulties. It is good practice to enclose the jar in a tightly fitting tin can, or to put the extract in a jar with a cover which clamps down tightly and is fitted with a thin cork disk in the top to aid in making a tight joint; many manufacturers are now marketing pilular extracts in jars fitted with covers of this character.

Pilular Extracts are solid or semi-solid products prepared by exhausting drugs with appropriate solvents and carefully evaporating the solutions to the proper consistence. These extracts preserve the useful constituents of the drug in a concentrated, relatively uniform and permanent condition, and in a form suitable for medication.

The solvents or menstrua employed in the preparation of pilular extracts are water, alcohol, or mixtures of these in the proportions stated in the formulas. A few drugs require for their extraction the addition of an acid or an alkali to the solvent. Where alcohol is used in the extraction it may be recovered by distillation.

In the preparation of pilular extracts the concentration of the solutions should be completed without delay, and undue exposure to heat must be avoided. The limit of temperature for the evaporation, as stated in the formulas, should not be exceeded. In the manufacture of these extracts on a large scale an apparatus for distilling and evaporating under reduced pressure should be used. It is also important that the residue be frequently stirred so as to hasten the evaporation and to obtain a uniform product.

Pilular extracts are extensively used in pill masses and in ointments and, to facilitate their use in these preparations, the degree of concentration is commonly directed to be that of a "pilular consistence."

They should be protected from exposure to sunlight and air by being kept in tightly-covered glass or earthen-ware containers.

Powdered Extracts.—These extracts are largely superseding soft extracts for reasons given in preceding paragraphs; the difficulty of making them arises from the injurious influence of heat upon concentrated percolates of organic substances, but by the use of vacuum apparatus, suitable absorptive diluents and care they can be made successfully.

They differ from pilular extracts in that they are dry, fine powders. Powdered extracts are often preferred to pilular extracts for general use, because they can be more accurately weighed, more easily dispensed, and more conveniently preserved in tightly-stoppered bottles.

In the preparation of powdered extracts, it is necessary to use solvents that will extract the active principles of the drugs, and only a minimum amount of the inert substances. Where the drug contains an oily constituent that would be extracted by the menstruum directed, it becomes necessary to adopt in the process of manufacture a method for the separation of this oil so that the product will retain a satisfactory, pulverulent form.

The concentration of the liquids containing the extractive should be completed without delay and undue exposure to heat must be avoided.

The limit of temperature as stated in the formulas should not be exceeded, and the use of apparatus for concentrating under reduced pressure is recommended. The final drying of the soft extract can be greatly facilitated by spreading it upon plates of glass or tinned metal and exposing it to currents of warm, dry air. Powdered extracts must be thoroughly dried, powdered and mixed with the diluent and preserved in tightly-stoppered, small, wide-mouthed, amber-colored bottles, and stored in a cool and dry place.

Alkaloidal standards have been adopted for Extracts that can be reliably assayed. Assay methods are directed for the determination of their strength, and to provide for standardization. When necessary, an inert diluent is directed to reduce the product to the standard. In the official formulas glucose is directed for the diluent in pilular extracts and dried starch and magnesium oxide are directed for powdered extracts, but it is permissible for the manufacturer to use as inert diluents for the latter, sugar, sugar of milk, powdered glycyrrhiza, magnesium carbonate or the finely powdered drug or marc from which the respective extract was made. For the convenience of the prescriber, the standards of strength for the Extracts have been adjusted, wherever possible, so that each bears a definite relation to that of the respective drug of average strength, and a statement of the standard precedes the the formula.

Abstracts.—A class of preparations known as Abstracts were official in the U. S. P. 1880. These were a form of powdered extracts bearing uniformly a definite relation to the drug, *i. e.*,—one part of Abstract representing two parts of drug. They were prepared by extracting 200 parts of the drug by percolation with a suitable menstruum, evaporating the percolate with 50 parts of sugar of milk to dryness, at not over 50° C. (122° F.) adding enough sugar of milk to make 100 parts and mixing thoroughly. Powdered Extracts which are more concentrated have largely replaced the abstracts. (See the Practice of Pharmacy, Fifth Edition, page 454.)

Official Extracts.—The extracts of the U. S. P. are *twenty-seven* in number, those of the N. F. IV, *thirteen* in number. Fifteen official extracts are pilular in consistence, *one* is a thick liquid, *two* form a brittle mass, and *twenty-two* are in powder form. Of these, *twenty-seven* are directed to be made with alcoholic menstrua of various strengths. In the U. S. P. these are Extracts of Aconite, Belladonna Leaves (Pilular), Belladonna Leaves (Powdered), Cannabis, Cimicifuga, Col-

chicum Corm, Colocynth, Ergot, Oxgall, Gelsemium, Hydrastis, Hyoscyamus, Nux Vomica, Physostigma, Rhubarb, Stramonium Pilular), Stramonium (Powdered), Sumbul, Taraxacum, and Viburnum Prunifolium. Those in the N. F. made with alcoholic menstrua are Extracts of Cinchona, Conium, Euonymus, Ignatia, Jalap, Leptandra, and Podophyllum.

Twelve official extracts are made with aqueous menstrua. In the U. S. P. these are Extracts of Cascara Sagrada, Gentian, Glycyrrhiza, Malt, and Opium. Those of the N. F. made with aqueous menstrua are Extracts of Aloes and Ergot (aqueous), Ferrated Extract of Apples, Extracts of Hematoxylon, Krameria, and Quassia, while *one* extract is percolated with water containing 5 per cent. of ammonia water,—*i.e.*, Pure Extract of Glycyrrhiza.

One extract is made by mixing extracts and a resin with aromatics, etc.,—*i.e.*, Compound Extract of Colocynth.

U. S. P. IX Extracts arranged in groups to show if Pilular or Powdered and also according to their Menstruum Strength

Pilular Extracts

Title and Menstruum	Relation of Extract to Drug	Fineness of Powder	Method of Preparation and Notes
Alcohol			
Extractum Cannabis	.....	20	Biological Assay required—Percolate in the usual manner until the drug is exhausted, recover the alcohol by distillation, evaporate the residue to pilular consistence at a temperature not exceeding 70° C. (158° F.) and assay the product, adjusting the strength, by adding glucose, to comply with the biological standard
Alcohol, 85; Water, 15			
Extractum Ergotæ	.....	40	Extract the 1000 Gm. of Ergot with petroleum benzin, dry the drug and then percolate to exhaustion, using first a mixture of 850 mils of Alcohol, 150 mils of Water and 10 mils of Hydrochloric Acid and then Alcohol and Water of the same proportion but omitting the Acid. Recover the alcohol by distillation and evaporate the residue, at a temperature not exceeding 70° C. (158° F.), with frequent stirring, to a pilular consistence
Alcohol, 4; Water, 1			
Extractum Sumbul	.....	30	Exhaust the drug by percolation in the usual manner, recover the alcohol by distillation and evaporate the residue, with frequent stirring, at a temperature not exceeding 70° C. (158° F.) to pilular consistence
Alcohol, 3; Water, 1			
Extractum Belladonnæ Foliorum (Pilular)	1 to 4	40	Assayed—It contains from 1.18 to 1.32 per cent. of Belladonna alkaloids Exhaust the drug by percolation in the usual manner, recover the alcohol by distillation and evaporate the residue, with frequent stirring, at a temperature not exceeding 70° C. (158° F.) to pilular consistence. Then assay a portion and adjust the remainder to contain 1.25 per cent. of Belladonna alkaloid
Hyoscyami	1 to 4	40	Assayed—It contains from 0.22 to 0.28 per cent. of Hyoscyamus alkaloids Prepare as directed for the Pilular Extract of Belladonna Leaves, adjusting the finished product to contain 0.25 per cent. of Hyoscyamus alkaloids
Stramonii (Pilular)	1 to 4	30	Assayed—It contains from 0.9 to 1.1 per cent. of Stramonium alkaloids Prepare as directed for the Pilular Extract of Belladonna Leaves, adjusting the finished product to contain 1 per cent. of Stramonium alkaloids
Alcohol, 125; Water, 875			
Extractum Taraxaci	.....	30	Exhaust the drug by percolation in the usual manner, recover the alcohol by distillation and evaporate the residue on a water bath, with frequent stirring, to pilular consistence
Water			
Extractum Glycyrrhizæ Purum	.....	20	Mix 150 mils of Ammonia Water with 3000 mils of Water and macerate 1000 Gm. of the drug for 24 hours with 1000 mils of this mixture. Then percolate in the usual manner, using first the remainder of the Ammonia mixture and then Chloroform Water until exhausted. Evaporate the percolate, on a water bath, to pilular consistence
Gentianæ	.....	20	Exhaust 1000 Gm. of the drug by percolation after 24 hours of maceration, evaporate the percolate to 2000 mils, strain, and again evaporate, on a water bath, to pilular consistence
Malti	.....	12	Macerate 1000 Gm. of the drug for 6 hours with 1000 mils of Water, then add 4000 mils of Water, heat to 60° C. (140° F.), and digest for 1 hour on a water bath at a temperature not exceeding 60° C. (140° F.). Strain with pressure, filter the strained liquid, and evaporate it on a water bath or in vacuum at not over 60° C. (140° F.) until of a specific gravity between 1.350 and 1.400 at 25° C. (77° F.)
Glycyrrhizæ	.....	.....	The *Commercial Extract* in rolls; not less than 60 per cent. of it should be soluble in cold water

Powdered Extracts

Title and Menstruum	Relation of Extract to Drug	Fineness of Powder	Method of Preparation and Notes
Alcohol			
Extractum Aconiti	1 to 4	60	Assayed—It contains from 1.8 to 2.2 per cent. of the ether-soluble alkaloids of Aconite A biological assay optional Dissolve 5 Gm. of Tartaric Acid in 500 mils of Alcohol, moisten 1000 Gm. of the drug with this mixture and percolate in the usual manner after 48 hours' maceration, using Alcohol as the menstruum. Reserve the first 1000 mils of percolate, recover the alcohol by distillation from the remaining percolate and, when the residue measures about 100 mils, add the reserved portion and again distil the alcohol until the residue is of syrupy consistence. Shake this residue with two successive portions of petroleum benzin of 250 mils each, to remove any fatty constituent, incorporate 50 Gm. of dried starch with the washed residue, and evaporate in a dish on a water bath, with a gentle heat and frequent stirring, until thick. Then spread on glass plates and dry in an air bath, at not over 70° C. (158° F.). Powder the product, weigh it, assay a portion and adjust the finished extract, by adding sufficient dried starch, to contain 2 per cent. of the ether-soluble alkaloids of Aconite. Pass the Extract through a fine sieve and preserve it in small, well-stoppered bottles
Belladonnæ Foliorum (Powdered)	1 to 4	40	Assayed—It contains from 1.18 to 1.32 per cent. of Belladonna alkaloids Exhaust 1000 Gm. of the drug by percolation in the usual manner, reserve the first 1000 mils of percolate, recover the alcohol by distillation from the remaining percolate and, when the residue measures about 100 mils, add the reserved portion and again distil the alcohol until the residue is of syrupy consistence. Evaporate this in a dish to pilular consistence at not over 70° C. (158° F.), incorporate 50 Gm. of dried starch and continue the low heat and frequent stirring until nearly dry. Now incorporate 20 Gm. of Magnesium Oxide, dry thoroughly in warm air, powder, weigh, assay, and add enough starch to make the finished extract contain 1.25 Gm. of Belladonna alkaloids. Pass the product through a fine sieve and preserve it in small, well-stoppered bottles
Cimicifugæ	1 to 4	40	Exhaust 1000 Gm. of the drug by percolation in the usual manner, recover the alcohol from the percolate by distillation, evaporate the residue to dryness, at not over 70° C. (158° F.), powder, and add enough dried starch to make 250 Gm. Sift the product and transfer to suitable bottles
Colchici Cormi	1 to 4	60	Assayed—It contains from 1.25 to 1.55 per cent. of Colchicine Prepare the Extract as directed for Extract of Aconite, using one additional washing with 100 mils of petroleum benzin and adjusting the finished extract to contain 1.4 per cent. of Colchicine
Fellis Bovis	1 to 8	.....	Add 1000 mils of Alcohol to 800 Gm. of Oxgall in a bottle, slowly and with agitation, and decant the liquid portion after 2 days. Again wash the residue in the bottle with 500 mils of Alcohol, decant as before, mix the alcoholic liquid and filter. Recover the alcohol by distillation and evaporate the residue to a thick extract at from 75° to 80° C. (167° to 176° F.), thoroughly dry this on glass plates, at not over 70° C. (158° F.), powder the product, weigh and add enough dried starch to make 100 Gm. Mix, sift, and transfer to suitable bottles
Gelsemii	1 to 4	40	Exhaust 1000 Gm. of the drug by percolation in the usual manner, distil the alcohol from the percolate until the residue in the still measures 500 mils, evaporate this in a dish, with frequent stirring, at not over 70° C. (158° F.), to a soft extract. Then incorporate 50 Gm. of a mixture of 1 part of Magnesium Oxide and 3 parts of dried Starch and dry the mixture on plates, in an air bath, at not over 70° C. (158° F.). Powder the product, add enough of the same diluting material to make 250 Gm., mix, sift, and transfer to suitable bottles

U. S. P. Powdered Extracts—*Continued*

Title and Menstruum	Relation of Extract to Drug	Fineness of Powder	Method of Preparation and Notes
Alcohol (*Continued*)			
Extractum Hydrastis	1 to 4	40	Assayed—It contains from 9 to 11 per cent. of the ether-soluble alkaloid of Hydrastis Dissolve 5 Gm. of Tartaric Acid in 1000 mils of Alcohol and exhaust 1000 Gm. of the drug by percolation in the usual manner, using first the acidified alcohol and then Alcohol. Recover the alcohol by distillation, evaporate the residue to a soft extract at not over 70° C. (158° F.), and complete the process as directed for Extract of Gelsemium, using the Magnesium Oxide and Starch mixture as a diluent, but adjusting the finished product to contain 10 per cent. of the ether-soluble alkaloids of Hydrastis
Stramonii (Powdered)	1 to 4	40	Assayed—It contains from 0.9 to 1.1 per cent. of Stramonium alkaloids Prepare the Extract as directed for Powdered Extract of Belladonna Leaves, adjusting the finished extract to contain 1 per cent. of Stramonium alkaloids
Alcohol, 4; Water, 1			
Extractum Rhei	1 to 2	40	Exhaust 1000 Gm. of the drug by percolation in the usual manner, recover the alcohol by distillation, evaporate the syrupy residue to dryness, in a dish, at not over 70° C. (158° F.), add 50 Gm. of Magnesium Oxide to the dry product and enough dried Starch to make 500 Gm. Powder the mixture, sift it, and transfer the product to suitable bottles
Alcohol, 3; Water, 1			
Extractum Nucis Vomicæ	.....	20	Assayed—It contains from 15.2 to 16.8 per cent. of Nux Vomica alkaloids Exhaust 1000 Gm. of the drug by percolation in the usual way. Recover the alcohol by distillation and when the liquid in the still measures about 200 mils, transfer it to a flask, add 150 mils of Water and wash with two successive portions of petroleum benzin, 200 and 100 mils, respectively. Now wash the separated benzin twice with a mixture of 100 mils of water and 10 mils of sulphuric acid, render the aqueous washings alkaline with ammonia and shake it out with chloroform. Add the chloroform washings to the original extract and evaporate the mixture to dryness on a water bath with frequent stirring Assay the product and add enough of a mixture of 1 part of Magnesium Oxide and 3 parts of dried Starch to make the finished Extract contain 16 per cent. of Nux Vomica alkaloids. Mix, powder, sift, and transfer the product to suitable bottles
Physostigmatis	1 to 13	60	Assayed—It contains from 1.7 to 2.3 per cent. of Physostigma alkaloids Dissolve 5 Gm. of Tartaric Acid in 1000 mils of the prescribed menstruum and exhaust 1000 Gm. of the drug by percolation in the usual manner, using first the acidified alcohol and then alcohol. Recover the alcohol by distillation and evaporate the residue to about 200 mils at not over 70° C. (158° F.) Transfer the concentrated liquid to a flask, add 100 mils of water and wash the mixture with two successive portions of petroleum benzin, 250 and 200 mils respectively. Discard the benzin and evaporate the washed liquid to pilular consistence at not over 70°C. (158° F.). Now add 20 Gm. of dried Starch and thoroughly dry by exposure to currents of warm air. Powder the product, assay, and add enough of the dried starch to make the finished extract contain 2 per cent. of Physostigma alkaloids. Mix, powder, sift and transfer the product to suitable bottles
Diluted Alcohol			
Extractum Colocynthidis	1 to 4	20	Macerate 1000 Gm. of the drug with 2000 mils of menstruum during 24 hours and then percolate slowly until the percolate measures 5000 mils. Recover the alcohol by distillation and evaporate the residue to dryness on a water bath. Powder the product, and add enough dried starch to make 250 Gm. Mix thoroughly, sift, and transfer to suitable bottles

U. S. P. Powdered Extracts—*Continued*

Title and Menstruum	Relation of Extract to Drug	Fineness of Powder	Method of Preparation and Notes
Diluted Alcohol (*Continued*)			
Extractum Colocynthidis Compositum	.....	.....	Triturate the following ingredients together until thoroughly mixed, sift the product and transfer it to suitable bottles; 160 Gm. Extract of Colocynth; 500 Gm. Aloes; 50 Gm. Cardamom Seed; 140 Gm. Resin of Scammony; 150 Gm. powdered Soap
Viburni Prunifolii	1 to 5	30	Extract 1000 Gm. of the drug by percolation in the usual manner, recover the alcohol by distillation, and evaporate the residue to a soft extract at not over 70° C.(158° F.). Add 5 Gm. of Magnesium Oxide, spread it out on glass plates to dry in warm air. Powder the product, add enough dried Starch to make 200 Gm., mix thoroughly, powder, sift, and transfer to suitable bottles
Water			
Extractum Cascaræ Sagradæ	1 to 3	20	Exhaust 900 Gm. of the drug by percolation with boiling water, evaporate the percolate to dryness on a water bath, powder the product, and add enough dried Starch to make the product weigh 300 Gm. Mix thoroughly, sift, and transfer the extract to suitable bottles
Opii	1 to 2	.....	Assayed—It contains from 19.5 to 20.5 per cent. of anhydrous Morphine Macerate 100 Gm. of Opium, cut into small pieces, with 300 mils of hot Water until reduced to a smooth paste, add 100 Gm. of sand, and percolate to exhaustion with Water. Evaporate the percolate to dryness on a water bath, powder the product, assay it and add enough dried Starch to make the Extract contain 20 per cent. of anhydrous Morphine. Mix thoroughly, sift, and transfer the extract to suitable bottles

N. F. IV Extracts, arranged in groups to show if Pilular or Powdered and also according to Menstruum Strength.

Pilular and Powdered Extracts

Title and Menstruum	Relation of Extract to Drug	Fineness of Powder	Method of Preparation and Notes
Alcohol			
Extractum Jalapæ	.....	60	Exhaust 1000 Gm. of the drug by percolation in the usual manner, reserve the first 900 mils of percolate, evaporate first the remaining percolate to 100 mils, and then the reserved portion, at not over 50° C. (122° F.), until the product is of a pilular consistence
Alcohol, 4; Water, 1			
Extractum Podophylli	.....	60	Prepare the Extract as directed for Extract of Jalap
Alcohol, 3; Water, 1			
Extractum Cinchonæ	.....	60	Assayed—It contains from 22 to 26 per cent. of Cinchona alkaloids Prepare a pilular extract as directed for Extract of Jalap, assay a portion of the product and add enough Glucose if necessary to make the finished extract contain 24 per cent. of Cinchona alkaloids
Diluted Alcohol			
Extractum Conii	.....	40	Assayed—It contains from 1.8 to 2.2 per cent. of Coniine Prepare a pilular extract as directed for Extract of Jalap, adding 3 mils of Diluted Hydrochloric Acid to the weaker portion of the percolate before evaporating and adjusting the finished product, by assay, and the addition of Glucose to contain 2 per cent. of Coniine
Water			
Extractum Ergotæ Aquosum	.....	30	Macerate 200 Gm. of the drug with 400 mils of Chloroform Water during 24 hours, then percolate with the same menstruum, at a rate of not more than 20 drops per minute, until the percolate measures 1000 mils. Evaporate this liquid on a water bath, at a moderate temperature, to 100 Gm., add 100 mils of Alcohol, allow the mixture to stand for 3 days, tightly covered, then filter and evaporate the filtrate on a water bath, at not over 50° C. (122° F.), to pilular consistence
Ferri Pomatum	.....	.....	Heat 1000 Gm. of Fresh Apple Juice with 40 Gm. of Reduced Iron on a water bath until gas is no longer evolved, adding Water to replace that evaporated. Then dilute with Water to 1000 Gm., set aside for several days, filter and evaporate the filtrate, on a water bath, to pilular consistence
Hæmatoxyli	.....	Rasped	Macerate 1000 Gm. of the drug with 10,000 mils of Water during 48 hours. Then boil the mixture, avoiding metallic utensils, until reduced to one-half the original volume. Then strain while hot and evaporate the strained liquid to dryness. (It is usually in the form of brittle masses)
Alcohol, 4; Water, 1			
Extractum Euonymi	1 to 4	40	Exhaust 1000 Gm. of the drug by percolation in the usual manner, recover the alcohol by distillation and evaporate the residue to dryness at not over 70° C. (158° F.), with frequent stirring. Powder the product and add enough dried Starch to make the extract weigh 250 Gm. Mix thoroughly, sift, and transfer to suitable bottles
Alcohol, 3; Water, 1			
Ignatiæ	.....	40	Assayed—It contains from 5.4 to 6.6 per cent. of Ignatia alkaloids Prepare a dry extract as directed for Extract of Euonymus, using, however, a temperature up to 100° C. (212° F.) during evaporation and adjusting the finished product by assay and the addition of dried Starch, to contain 6 per cent. of Ignatia alkaloids
Leptandræ	1 to 4	30	Prepare an Extract as directed for Extract of Euonymus
Water			
Extractum Aloes	1 to 2	20	Thoroughly disintegrate 1000 Gm. of the Aloes by stirring it with 10,000 mils of boiling Water, then allow it to stand 12 hours. Pour off the clear liquid, strain the remainder and evaporate the mixed liquid to dryness on a water bath. Powder the product, add enough dried starch to weigh 500 Gm., mix thoroughly, sift, and transfer to suitable bottles

N. F. Powdered Extracts—*Continued*

Title and Menstruum	Relation of Extract to Drug	Fineness of Powder	Method of Preparation and Notes
Water (*Continued*)			
Krameriæ	1 to 4	30	Percolate 1000 Gm. of the drug with Water until exhausted, heat the percolate to boiling, strain, and evaporate to dryness, on a water bath, at not over 70° C. (158° F.) Powder the product, add enough dried starch to make 250 Gm., mix thoroughly, sift and transfer to suitable bottles
Quassiæ	1 to 10	20	Percolate 1000 Gm. of the drug with water until exhausted, evaporate the percolate to three-fourths of its bulk by boiling, then strain, and evaporate the liquid to dryness on a water bath. Powder the product, add enough dried Starch to make 100 Gm., mix thoroughly, sift, and transfer the product to suitable bottles

U.S.P. IX Extracts

Pilular

Extractum Belladonnæ Foliorum
Cannabis
Ergotæ
Gentianæ
Glycyrrhizæ Purum
Hyoscyami
Malti (semi-solid)
Stramonii
Sumbul
Taraxaci

Solid

Extractum Glycyrrhizæ

Powdered

Extractum Aconiti
Belladonnæ Foliorum
Cascaræ Sagradæ
Cimicifugæ
Colchici Cormi
Colocynthidis
Colocynthidis Compositum
Fellis Bovis
Gelsemii
Hydrastis
Nucis Vomicæ
Opii
Physostigmatis
Rhei
Stramonii
Viburni Prunifolii

N.F. IV Extracts

Pilular

Extractum Cinchonæ
Conii
Ergotæ Aquosum
Ferri Pomatum
Jalapæ
Podophylli

Solid

Extractum Hæmatoxyli

Powdered

Extractum Aloes
Euonymi
Ignatiæ
Krameriæ
Leptandræ
Quassiæ

Unofficial Extracts

Name	Fineness of Powder	Quantity to moisten 1000 Gm. of Drug	Quantity of Percolate reserved for 1000 Gm. of Drug	Menstruum	Process
Extractum Arnicæ Radicis. U. S. P. 1890	60	400	900	Diluted Alcohol	Percolate 1000 Gm. of Arnica Root and continue the operation as directed under Extractum Jalapæ (page 616)
Belladonnæ Viride. Br., 1898	..	...	...	.....	Bruise the fresh leaves and young branches of Belladonna in a mortar, press out the juice and heat to 54.4° C.(129.9° F.). Separate the green coloring matter by straining, and evaporate the strained liquid, after heating to 93.3° C.(199.9° F.) and filtering, to a thin syrupy consistence. Then add the green coloring matter and evaporate the whole, at a temperature not exceeding 60° C. (140° F.) to a soft extract
Colchici. Br., 1914	..	...	...	.....	Crush fresh Colchicum Corms, deprived of their coats; press, set the liquid aside, decant clear portion, heat to 100° C. (212° F.), strain and evaporate to a soft extract at a temperature not exceeding 70° C.(158°F.)
Strophanthi. Br., 1914	30	...	...	Alcohol	Exhaust 25 Gm. of Strophanthus Seeds with Ether, dry the marc, and again percolate with Alcohol, after forty-eight hours maceration, to make 250 mils. Evaporate the liquid until it thickens, add sufficient powdered Sugar of Milk to make the product weigh 50 Gm. and powder

EXTRACTUM ACONITI. U. S. Extract of Aconite

[Ext. Aconit. Powdered Extract of Aconite]

Extract of Aconite yields not less than 1.8 per cent. nor more than 2.2 per cent. of the ether-soluble alkaloids of aconite and, if assayed biologically, the minimum lethal dose should not be greater than 0.00001 Gm. for each gramme of body weight of guinea-pig. One Gm. of the Extract represents about 4 Gm. of aconite.

	Metric	Old form
***Aconite,** in No. 60 powder	**1000 Gm.**	32 oz. av.
Tartaric Acid	**5 Gm.**	70 gr.
Purified Petroleum Benzin,		
Starch, dried at 100° C. (212° F.),		
Alcohol, each, a sufficient quantity.		

Dissolve the tartaric acid in 500 mils [old form 1 pint] of alcohol, moisten the drug with this solution and pack it in a cylindrical glass percolator; then add sufficient alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed very slowly, adding alcohol as required. Reserve the first 1000 mils [old form 2 pints] of percolate and continue the percolation, until the second percolate measures 1000 mils [old form 2 pints] or until the drug is exhausted. Transfer this second percolate to a suitable apparatus and

distil off the alcohol at as low a temperature as practicable, until a residue measuring about 100 mils [old form about 4 fl. oz.] remains, then add the reserved percolate and continue distillation until the residue in the still is of syrupy consistence.

Transfer this syrupy residue to a flask, using a little warm alcohol to rinse the still, and adding the rinsing to the flask. When it has cooled, add 250 mils [old form 8 fl. oz.] of purified petroleum benzin and shake the mixture thoroughly for several minutes. Allow the liquids to separate and decant the benzin layer as closely as possible; add again to the residue 250 mils [old form 8 fl. oz.] of purified petroleum benzin, agitate and decant the benzin layer as before.

Transfer the syrupy residue to a shallow evaporating dish, rinse the flask with 20 mils [old form 5 fl. dr.] of warm alcohol, adding the rinsings to the residue in the dish, and then incorporate 50 Gm. [old form 1 oz. av. 262 grains] of the thoroughly dried starch. Evaporate the mixture by a very gentle heat on a water bath, frequently stirring, and, when the mass has become thick, spread it on glass plates and continue the drying in an air bath at a temperature not exceeding 70° C. (158° F.) until thoroughly dry. Reduce the product to a fine powder and weigh it.

Assay a portion of this product as directed below, and, from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloids in the remainder of the powder and add to this enough of the dried starch to make the finished Extract contain 2 per cent. of the ether-soluble alkaloids of aconite. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

Assay.—Introduce 3 Gm. of Extract of Aconite into a 250 mil flask, add 10 Gm. of washed sand and mix thoroughly. Then add 150 mils of ether and 2 mils of ammonia water, shake the mixture vigorously every few minutes during a half hour, and when the dregs have settled decant 100 mils of the clear liquid, representing 2 Gm. of the Extract. Proceed as directed under *Belladonnæ Radix*, beginning with the word "Filter" in the seventh line of the Assay, modifying the process there given by using ether instead of chloroform for the final shaking out of the alkaloids.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 64.539 milligrammes of the ether-soluble alkaloids of aconite.

For an alternative method of assaying Extract of Aconite see Biological Assays (Chapter LXII).

Average dose.—1/6 grain (0.01 Gm.).

EXTRACTUM BELLADONNÆ FOLIORUM. U. S. Extract of Belladonna Leaves

[Ext. Bellad. Fol.]

Extract of Belladonna Leaves yields not less than 1.18 per cent. nor more than 1.32 per cent. of the alkaloids of belladonna leaves. One Gm. of the Extract represents about 4 Gm. of belladonna leaves.

Pilular Extract of Belladonna Leaves

	Metric	Old form
***Belladonna Leaves**, in No. 40 powder.....	**1000 Gm.**	32 oz. av.
Glucose,		
Alcohol,		
Water, each, a sufficient quantity.		

Moisten the powder with sufficient of a mixture of 3 volumes of

alcohol and 1 volume of water and pack it firmly in a cylindrical percolator, then add enough menstruum, using the same proportion of alcohol and water as before, to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum of the same strength, until the percolate measures 3000 mils [old form 6 pints] or until the belladonna leaves are exhausted. Recover the alcohol from the percolate by distillation and evaporate the residue with frequent stirring, at a temperature not exceeding 70° C. (158°F.), to a pilular consistence. Mix the mass thoroughly and weigh it.

Assay a portion of this extract, as directed below, and, from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloids in the remainder of the mass, and to this add enough glucose to make the finished Extract contain 1.25 per cent. of the alkaloids of belladonna leaves. Mix thoroughly.

Assay.—Dissolve 2 Gm. of Pilular Extract of Belladonna Leaves in 10 mils of diluted alcohol, transfer the solution to a separator and wash the vessel in which the extract was dissolved with 2 mils of ammonia water previously diluted with 10 mils of distilled water, in divided portions, adding the rinsings to the separator, then proceed as directed under *Fluidextractum Belladonnæ Radicis*, second line of the Assay, beginning with the word "Completely," modifying the process there given by treating the residue twice with 5 mils of ether and evaporating to dryness each time before titration.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 28.92 milligrammes of the alkaloids of belladonna leaves.

U. S. P. Preparation.—(Form Pilular Extract.) Unguentum Belladonnæ.

N. F. Preparations.—(Form Pilular Extract.) Pilulæ Aloes et Podophylli Compositæ; Pilulæ Aloini Compositæ; Pilulæ Aloini, Strychninæ et Belladonnæ; Pilulæ Aloini, Strychninæ et Belladonnæ Compositæ; Pilulæ Antidispepticæ; Pilulæ Laxativæ Compositæ.

Powdered Extract of Belladonna Leaves

	Metric	Old form
***Belladonna Leaves,** in No. 40 powder	**1000 Gm.**	32 oz. av.
Magnesium Oxide	**20 Gm.**	280 gr.
Starch, dried at 100° C. (212° F.),		
Alcohol, each, a sufficient quantity.		

Moisten the drug with sufficient alcohol and pack it in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed very slowly, adding alcohol as required. Reserve the first 1000 mils [old form 2 pints] of percolate and continue the percolation until the second percolate measures 1000 mils [old form 2 pints] or until the drug is exhausted. Transfer the second percolate to a suitable apparatus and distil off the alcohol at as low a temperature as practicable, until a residue measuring about 100 mils [old form 4 fl. oz.] remains, then add the reserved percolate and continue distillation until the residue in the still is of syrupy consistence.

Transfer this syrupy residue to a shallow evaporating dish, rinse the flask or still with a small quantity of warm alcohol, adding the rinsing to the residue in a dish. Evaporate this extract to a pilular consistence, at a temperature not exceeding 70° C. (158° F.), then add 50 Gm. [old form 1 oz. av. 262 grains] of the dried starch and continue the heating,

with frequent stirring, until the mass is nearly dry. Now add the magnesium oxide, thoroughly incorporate it and set the product aside in a current of warm air, until thoroughly dry. Reduce the product to a fine powder and weigh it.

Assay a portion of this product as directed below, and, from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloids in the remainder of the powder and add to this enough of the dried starch to make the finished Extract contain 1.25 per cent. of the alkaloids of belladonna leaves. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

Assay.—Introduce 3 Gm. or Powdered Extract of Belladonna Leaves into a 250 mil flask, add 10 Gm. of washed sand and mix thoroughly. Then add 150 mils of a mixture of chloroform, 1 volume, and ether, 2 volumes, followed by 5 mils of ammonia water. Shake the mixture vigorously every ten minutes during a half hour and when the dregs have settled decant 100 mils of the clear liquid, representing 2 Gm. of the Extract; now proceed as directed under *Belladonnæ Radix*, seventh line of the Assay, modifying the process there given by treating the residue twice with ether, and evaporating to dryness each time before titration.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 28.92 milligrammes of the alkaloids of belladonna leaves.

Average dose.— ¼ grain (0.015 Gm.).

The U. S. P. has introduced both Pilular and Powdered Extracts of Belladonna Leaves under the one Latin title. This provides the powdered form for pills and capsules should the pharmacist prefer to use it and also the pilular Extract, which is completely soluble in the menstruum, and, consequently, much better adapted for the making of Belladonna Ointment.

EXTRACTUM CANNABIS. U. S. Extract of Cannabis

[Ext. Cannab. Extractum Cannabis Indicæ, U. S. P. VIII]

Extract of Cannabis, when assayed biologically, produces incoördination when administered to dogs in a dose of not more than 0.004 Gm. of Extract per kilogramme of body weight.

	Metric	Old form
***Cannabis**, in No. 20 powder.....	**1000 Gm.**	32 oz. av.
Alcohol, a sufficient quantity.		

Moisten the powder with sufficient alcohol, pack it firmly in a cylindrical percolator and add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the drug is exhausted. Recover the alcohol from the percolate by distillation and evaporate the residue with frequent stirring, at a temperature not exceeding 70° C. (158° F.), to a pilular consistence. Mix the mass thoroughly and weigh it.

Assay a portion of this extract, and from the result thus obtained adjust the weight of the finished Extract, by the addition of glucose, to conform to the required biological standard.

Assay.—Proceed as directed under Biological Assays (Chapter LXII).

N. F. Preparation.—Mistura Chlorali et Potassii Bromidi Composita.

Average dose.—1/6 grain (0.01 Gm.).

EXTRACTUM CASCARÆ SAGRADÆ. U. S. Extract of Cascara Sagrada

[Ext. Casc. Sagr. Extractum Rhamni Purshianæ, U. S. P. VIII Powdered Extract of Cascara Sagrada]

One Gm. of the Extract represents 3 Gm. of cascara sagrada.

	Metric	Old form
*Cascara Sagrada, in No. 20 powder	900 Gm.	30 oz. av.
Magnesium Oxide	25 Gm.	364 gr.
Starch, dried at 100° C. (212° F.),		
Boiling Water, each, a sufficient quantity,		
To make	300 Gm.	10 oz. av.

Mix the cascara sagrada with 4000 mils [old form 8 pints] of boiling water and macerate the mixture during three hours. Then transfer it to a metallic percolator, allow it to drain and pour on boiling water until the percolate measures 5000 mils [old form 10 pints] or the drug is exhausted. Evaporate the percolate to dryness on a water bath or steam bath, reduce the extract to a fine powder, weigh it, add the magnesium oxide and enough of the dried starch to make the product weigh 300 Gm. [old form 12 oz. av.]. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

N. F. Preparations.—Pilulæ Aloini, Strychninæ et Belladonnæ Compositæ.

Average dose.—4 grains (0.25 Gm.).

EXTRACTUM CIMICIFUGÆ. U. S. Extract of Cimicifuga

[Ext. Cimicif. Powdered Extract of Cimicifuga]

One Gm. of the Extract represents 4 Gm. of cimicifuga.

	Metric	Old form
*Cimicifuga, in No. 40 powder	1000 Gm.	32 oz. av.
Alcohol,		
Starch, dried at 100° C. (212° F.), each, a sufficient quantity,		
To make	250 Gm.	8 oz. av

Moisten the drug with sufficient alcohol, pack it in a cylindrical percolator, and add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, adding alcohol as required until the drug is exhausted. Recover the alcohol from the percolate by distillation and evaporate the residue to dryness, with frequent stirring, at a temperature not exceeding 70°C. (158° F.). Weigh the residue and add sufficient of the dried starch to make the product weigh 250 Gm. [old form 8 oz. av.]. Reduce the mixture to a fine powder, mix thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

Average dose.—4 grains (0.25 Gm.).

EXTRACTUM COLCHICI CORMI. U. S. Extract of Colchicum Corm

[Ext. Colch. Corm. Powdered Extract of Colchicum Corm]

Extract of Colchicum Corm yields not less than 1.25 per cent. nor more than 1.55 per cent. of colchicine. One Gm. of the Extract represents about 4 Gm. of colchicum corm.

	Metric	Old form
***Colchicum Corm**, in No. 60 powder.....	**1000 Gm.**	**32 oz. av.**
Alcohol,		
Purified Petroleum Benzin,		
Starch, dried at 100° C. (212° F.), each, a sufficient quantity.		

Moisten the drug with sufficient alcohol, pack it in a cylindrical percolator and add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, adding alcohol as required, until the percolate measures 2000 mils [old form 4 pints] or until the drug is exhausted. Recover the alcohol from the percolate by distillation at as low a temperature as practicable until a residue measuring about 150 mils [old form 4 fl. oz. 384 minims] remains in the still. Transfer this residue to a flask, using a little warm alcohol to rinse the still, and add the rinsings to the flask. When it has cooled, add 250 mils [old form 8 fl. oz.] of purified petroleum benzin and shake the mixture thoroughly for several minutes. Allow the liquids to separate and decant the benzin layer as closely as possible; again add to the residue 150 mils [old form 4 fl. oz. 384 minims] of purified petroleum benzin, agitate and decant the benzin layer as before, repeat the washing with 100 mils [old form 4 fl. oz.] of purified petroleum benzin and reject the benzin washings.

Transfer the residue to a shallow evaporating dish, rinse the flask with a little warm alcohol, adding the rinsings to the residue in the dish, and evaporate it on a water bath to a thick extract. To this add 50 Gm. [old form 1 oz. av. 262 grains] of the dried starch, mix well, spread the mixture on glass plates and continue the drying in an air bath at a temperature not exceeding 70° C. (158° F.) until thoroughly dry. Reduce the product to a fine powder and weigh it.

Assay a portion of this product as directed below, and, from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloid in the remainder of the powder and add to this enough of the dried starch to make the finished Extract contain 1.4 per cent. of colchicine. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small wide-mouthed bottles and stopper them tightly.

Assay.—Proceed as directed under *Colchici Semen*, modifying the process there given by using 6 Gm. of the Extract of Colchicum Corm instead of 15 Gm. of colchicum seed. The final weight will be the amount of colchicine from 2 Gm. of Extract of Colchicum Corm.

Average dose.—1 grain (0.06 Gm.).

EXTRACTUM COLOCYNTHIDIS. U. S. Extract of Colocynth

[Ext. Colocynth. Powdered Extract of Colocynth]

One Gm. of the Extract represents 4 Gm. of colocynth.

	Metric	Old form
*Colocynth, in No. 20 powder	1000 Gm.	32 oz. av
Diluted Alcohol,		
Starch, dried at 100° C. (212° F.), each, a sufficient quantity,		
To make	250 Gm.	8 oz. av.

Moisten the drug with 2000 mils [old form 4 pints] of diluted alcohol and macerate it in a closed vessel for twenty-four hours, then transfer the moist drug to a cylindrical percolator, shake it down evenly without packing, and gradually pour diluted alcohol upon it, allowing the percolation to proceed slowly, until the percolate measures 5000 mils [old form 10 pints]. Recover the alcohol from the percolate by distillation and evaporate the residue to dryness on a water bath or steam bath. Reduce the extract to a fine powder, weigh it, and add sufficient of the dried starch to make the product weigh 250 Gm. [old form 8 oz. av.]. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

U. S. P. Preparation.—Extractum Colocynthidis Compositum.

N. F. Preparations.—Pilulæ Colocynthidis Compositæ; Pilulæ Colocynthidis et Hyoscyami.

Average dose.—½ grain (0.03 Gm.).

EXTRACTUM COLOCYNTHIDIS COMPOSITUM. U. S. Compound Extract of Colocynth

[Ext. Colocynth. Co. Powdered Compound Extract of Colocynth]

	Metric	Old form
*Extract of Colocynth	160 Gm.	5 oz. av. 52 gr.
Aloes	500 Gm.	16 oz. av.
Cardamom Seed, in No. 60 powder	50 Gm.	1 oz. av. 262 gr.
Resin of Scammony, in No. 60 powder	140 Gm.	4 oz. av. 210 gr.
Soap, dried and in powder	150 Gm.	4 oz. av. 350 gr;
To make	1000 Gm.	32 oz. av.

Triturate the ingredients until the product is reduced to a No. 60 powder. Pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

U. S. P. Preparation.—Pilulæ Catharticæ Compositæ.

N. F. Preparations.—Pilulæ Antidyspepticæ; Pilulæ Catharticæ Vegetabiles; Pilulæ Colocynthidis et Podophylli; Pilulæ Laxativæ Post Partum.

Average dose.—4 grains (0.25 Gm.).

EXTRACTUM ERGOTÆ. U. S. Extract of Ergot

[Ext. Ergot.]

	Metric	Old form
*Ergot, in No. 40 powder	1000 Gm.	32 oz. av.
Hydrochloric Acid	10 mils	2½ fl. dr.
Purified Petroleum Benzin,		
Alcohol,		
Water, each, a sufficient quantity.		

Pack the ergot in a percolator and slowly percolate it with purified petroleum benzin until a few drops of the percolate, evaporated on

filter paper, leave no greasy stain. Reject the benzin percolate, remove the ergot from the percolator and dry it by exposure to the air. Mix 850 mils [old form 27 fl. oz. 96 minims] of alcohol with 150 mils [old form 4 fl. oz. 384 minims] of water, add the hydrochloric acid to 400 mils [old form 12 fl. oz. 384 minims] of this mixture, and moisten the ergot with the acid mixture. Pack it in a cylindrical percolator and macerate for six hours, then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportion of alcohol and water as before, until the drug is exhausted. Recover the alcohol from the percolate by distillation and evaporate the residue, with frequent stirring, at a temperature not exceeding 70° C. (158° F.), to a pilular consistence.

Average dose.—4 grains (0.25 Gm.).

EXTRACTUM FELLIS BOVIS. U. S. Extract of Oxgall
[Ext. Fel. Bov. Powdered Extract of Oxgall]

One Gm. of the Extract represents 8 Gm. of oxgall.

	Metric	Old form
*Oxgall	800 Gm.	32 oz. av.
Alcohol	1500 mils	3¾ pints
Starch, dried at 100° C. (212° F.), a sufficient quantity,		
To make	100 Gm.	4 oz. av.

Add 1000 mils [old form 2½ pints] of alcohol slowly and with agitation to the oxgall contained in a bottle of sufficient size. Allow the mixture to stand for two days and then decant the liquid portion. Wash the residue in the bottle with an additional 500 mils [old form 1¼ pints] of alcohol, decant the liquid portion, mix it with the liquid first separated and filter the mixture. Recover the alcohol from the filtrate by distillation, transfer the residue to a shallow dish and evaporate it to a thick extract at a temperature between 75° and 80° C. (167° and 176° F.). Spread this extract on glass plates and continue the drying by exposure to warm air, at a temperature not exceeding 70° C. (158° F.), until thoroughly dry. Reduce the extract to a fine powder, weigh it and add sufficient of the dried starch to make the product weigh 100 Gm. [old form 4 oz. av.] Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

Average dose.—1½ grains (0.1 Gm.).

EXTRACTUM GELSEMII. U. S. Extract of Gelsemium
[Ext. Gelsem. Powdered Extract of Gelsemium]

One Gm. of the Extract represents 4 Gm. of gelsemium.

	Metric	Old form
*Gelsemium, in No. 40 powder	1000 Gm.	32 oz. av.
Alcohol,		
Magnesium Oxide,		
Starch, dried at 100° C. (212° F.), each, a sufficient quantity,		
To make	250 Gm.	8 oz. av.

Moisten the drug with sufficient alcohol, pack it in a cylindrical percolator and add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, adding alcohol as required, until the drug is exhausted. Recover the alcohol from the percolate by distillation, at as low a temperature as practicable, until a residue measuring about 500 mils [old form 1 pint] remains in the still. Transfer this residue to a shallow dish, and evaporate it to a soft extract with frequent stirring, at a temperature not exceeding 70° C. (158° F.). Then add 50 Gm. [old form 1 oz. av. 262 grains] of a mixture of 1 part of magnesium oxide and 3 parts of the dried starch, mix well, spread the mass in a thin layer on glass or tinned-metal plates or in a porcelain dish and continue the drying in an air bath, at a temperature not exceeding 70° C. (158° F.), until thoroughly dry. Reduce the extract to a fine powder, weigh it, and add sufficient of the mixture of magnesium oxide and dried starch, made in the same proportion as before, to make the finished product weigh 250 Gm. [old form 8 oz. av.]. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

Average dose.—$\frac{1}{6}$ grain (0.01 Gm.).

EXTRACTUM GENTIANÆ. U. S. Extract of Gentian
[Ext. Gentian.]

	Metric	Old form
***Gentian**, in No. 20 powder.....	**1000 Gm.**	**32 oz. av.**
Water, a sufficient quantity.		

Moisten the powder with sufficient water, and allow it to macerate for twenty-four hours; then pack it in a conical percolator, and gradually pour water upon it until the drug is exhausted. Reduce the liquid to 2000 mils [old form 4 pints] by boiling, strain it, and then evaporate it to a pilular consistence on a water bath.

N. F. Preparations.—Pilulæ Antiperiodicæ; Pilulæ Ferri, Quininæ, Aloes et Nucis Vomicæ.

Average dose.—4 grains (0.25 Gm.).

EXTRACTUM GLYCYRRHIZÆ. U. S. Extract of Glycyrrhiza
[Ext. Glycyrrh. Extract of Licorice]

The commercial Extract of Glycyrrhiza.

In flattened, cylindrical rolls or in masses, of a glossy black color externally; fracture brittle, sharp, smooth, conchoidal; taste characteristic and sweet. When pulverized it yields a brown powder. Not less than 60 per cent. of Extract of Glycyrrhiza is soluble in cold water. The yield of ash does not exceed 6 per cent.

U. S. P. Preparations.—Pilulæ Ferri Iodidi; Trochisci Ammonii Chloridi; Trochisci Cubebæ.

N. F. Preparation.—Pilulæ ad Prandium (Hall's).

EXTRACTUM GLYCYRRHIZÆ PURUM. U. S. Pure Extract of Glycyrrhiza

[Ext. Glycyrrh. Pur.]

	Metric	Old form
*Glycyrrhiza, in No. 20 powder	1000 Gm.	32 oz. av.
Ammonia Water	150 mils	about 4½ fl. oz.
Water,		
Chloroform Water, each, a sufficient quantity.		

Mix the ammonia water with 3000 mils [old form 6 pints] of water, and, having moistened the powder with 1000 mils [old form 2 pints] of the mixture, allow it to macerate in a closed vessel for twenty-four hours. Then pack it lightly in a cylindrical percolator, and gradually pour upon it, first the remainder of the menstruum, and then chloroform water, until the glycyrrhiza is exhausted. Evaporate the liquid in a porcelain dish on a water bath, to a pilular consistence.

U. S. P. Preparations.—Fluidextractum Cascaræ Sagradæ Aromaticum; Mistura Glycyrrhizæ Composita.

N. F. Preparations.—Mistura Ammonii Chloridi; Mistura Olei Picis.

EXTRACTUM HYDRASTIS. U. S. Extract of Hydrastis

[Ext. Hydrast. Extract of Golden Seal Powdered Extract of Hydrastis]

Extract of Hydrastis yields not less than 9 per cent. nor more than 11 per cent. of the ether-soluble alkaloids of hydrastis. One Gm. of the Extract represents about 4 Gm. of hydrastis.

	Metric	Old form
*Hydrastis, in No. 40 powder	1000 Gm.	32 oz. av.
Tartaric Acid	5 Gm.	70 gr.
Alcohol,		
Magnesium Oxide,		
Starch, dried at 100° C. (212° F.), each, a sufficient quantity.		

Dissolve the tartaric acid in 1000 mils [old form 2 pints] of alcohol, moisten the drug with sufficient of this solution and pack in a cylindrical percolator; then add enough of the acidified alcohol, followed by alcohol if necessary, to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, adding alcohol as required, until the drug is exhausted. Recover the alcohol from the percolate by distillation, and evaporate the residue to a soft extract, with frequent stirring, at a temperature not exceeding 70° C. (158° F.). Add 50 Gm. [old form 1 oz. 262 grains] of a mixture of *one part* of magnesium oxide and *three parts* of the dried starch, mix thoroughly and spread the mass in a thin layer on glass or tinned-metal plates or in a porcelain dish and continue the drying in an air bath at a temperature not exceeding 70° C. (158° F.), until thoroughly dry. Then reduce the extract to a fine powder and weigh it.

Assay a portion of this product as directed below, and, from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloids in the remainder of the powder and add to this enough of the mixture of magnesium oxide and dried starch, made in the same pro-

portion as before, to make the finished Extract contain 10 per cent. of the ether-soluble alkaloids of hydrastis. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

Assay.—Introduce 3 Gm. of Extract of Hydrastis into a 250-mil flask, add 10 Gm. of washed sand and mix thoroughly. Then add 150 mils of ether and 5 mils of ammonia water. Shake the mixture vigorously every ten minutes during a half hour, and when the dregs have settled decant 100 mils of the clear liquid, representing 2 Gm. of the Extract. Proceed as directed under *Belladonnæ Radix*, seventh line of the Assay, modifying the process there given by using ether instead of chloroform for the final shaking out of the alkaloids, and drying the residue to constant weight at 100° C. (212° F.), instead of titrating it. The weight will be the amount of ether-soluble alkaloids from 2 Gm. of Extract of Hydrastis.

Average dose.—8 grains (0.5 Gm.).

EXTRACTUM HYOSCYAMI. U. S. Extract of Hyoscyamus [Ext. Hyosc.]

Extract of Hyoscyamus yields not less than 0.22 per cent. nor more than 0.28 per cent. of the alkaloids of hyoscyamus. One Gm. of the Extract represents about 4 Gm. of hyoscyamus.

	Metric	Old form
***Hyoscyamus,** in No. 40 powder	**1000 Gm.**	32 oz. av.
Glucose,		
Alcohol,		
Water, each, a sufficient quantity.		

Moisten the powder with sufficient of a mixture of 3 volumes of alcohol and 1 volume of water, pack it firmly in a cylindrical percolator and add enough menstruum, using the same proportion of alcohol and water as before, to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum of the same strength, until the drug is exhausted. Recover the alcohol by distillation and evaporate the residue, with frequent stirring, at a temperature not exceeding 70° C. (158° F.), until it is reduced to a pilular consistence. Mix the mass thoroughly and weigh it.

Assay a portion of this extract as directed below, and, from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloids in the remainder of the mass and to this add enough glucose to make the finished Extract contain 0.25 per cent. of the alkaloids of hyoscyamus. Mix thoroughly.

Assay.—Proceed as directed under *Extractum Belladonnæ Foliorum* (Pilular), modifying the process there given by using 5 Gm. of Extract of Hyoscyamus instead of 2 Gm. of extract of belladonna leaves.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 28.92 milligrammes of the alkaloids of hyoscyamus.

N. F. Preparations.—Pilulæ Catharticæ Vegetabiles; Pilulæ Colocynthidis et Hyoscyami; Pilulæ Laxativæ Post Partum.

Average dose.—1 grain (0.06 Gm.).

EXTRACTUM MALTI. U. S. Extract of Malt
[Ext. Malt.]

	Metric	Old form
***Malt**, in coarse powder (not finer than No. 12)...	**1000 Gm.**	32 oz. av.
Water, a sufficient quantity.		

Pour 1000 mils [old form 2 pints] of water upon the powder contained in a suitable vessel and macerate for six hours, then add 4000 mils [old form 8 pints] of water, heated to 60° C. (140° F.), and digest the mixture for one hour on a water bath at a temperature not exceeding 60° C. (140° F.). Strain the mixture, express, filter the strained liquid, and, by means of a water bath or vacuum apparatus, evaporate the liquid, at a temperature not exceeding 60° C. (140° F.), until it has a specific gravity of not less than 1.350 nor more than 1.400 at 25° C. (77° F.).

N. F. Preparation.—Emulsum Olei Morrhuæ cum Malto.

Average dose.—4 drachms (15 Gm.).

EXTRACTUM NUCIS VOMICÆ. U. S. Extract of Nux Vomica
[Ext. Nuc. Vom. Powdered Extract of Nux Vomica Nucis Vomicæ Extractum, P. I.]

Extract of Nux Vomica yields not less than 15.2 per cent. nor more than 16.8 per cent. of the alkaloids of nux vomica.

	Metric	Old form
***Nux Vomica**, in No. 20 powder.....	**1000 Gm**	32 oz. av.
Alcohol,		
Water,		
Purified Petroleum Benzin,		
Diluted Sulphuric Acid,		
Ammonia Water,		
Chloroform,		
Magnesium Oxide,		
Starch, dried at 100° C (212° F.), each, a sufficient quantity.		

Moisten the drug with sufficient of a mixture of 3 volumes of alcohol and 1 volume of water, pack it firmly in a cylindrical percolator, and add enough of the menstruum, using the same proportion of alcohol and water as before, to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding the menstruum as required, until the percolate passes but faintly imbued with bitterness, and the drug is exhausted. Recover the alcohol from the percolate by distillation at as low a temperature as practicable and concentrate the liquid until the residue measures about 200 mils [old form about 6½ fl. oz.]. Transfer this residue to a flask or separator, using a little warm menstruum made of the same proportion of alcohol and water originally used, to rinse the still, and add the rinsing to the separator. Then add 150 mils [old form about 5 fl. oz.] of water and 200 mils [old form about 6½ fl. oz.] of purified petroleum benzin and shake the mixture thoroughly for several minutes. Allow the liquids to separate and decant the benzin layer as closely as possible; again add to the residue 100 mils [old form about 3¼ fl. oz.] of purified petroleum benzin, agitate, and decant the benzin as before.

Wash the mixed benzin solutions, in a separator, with a mixture of 100 mils [old form about 3¼ fl. oz.] of water and 10 mils [old form 2½ fl. dr.] of diluted sulphuric acid, separate the aqueous layer and repeat the washing twice with fresh portions, 100 mils [old form about 3¼ fl. oz.] each, of water and acid made in the same proportion as before. Collect the aqueous solutions in a separator, render the liquid alkaline by the addition of ammonia water and shake it out with three portions of chloroform, 20 mils [old form 5 fl. dr.], 10 mils [old form 2½ fl. dr.], and 10 mils [old form 2½ fl. dr.], respectively. Add the combined chloroform solutions to the extract and evaporate the mixture to dryness on a water bath with frequent stirring.

Assay a portion of this product as directed below, and, from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloids in the remainder of the product and add to this enough of a mixture of magnesium oxide, 1 part, and of the dried starch, 3 parts, to make the finished Extract contain 16 per cent. of the alkaloids of nux vomica. Reduce the mixture to a fine powder, mix thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

Assay.—Introduce 3 Gm. of Extract of Nux Vomica into a 250-mil flask, add 10 Gm. of washed sand and mix thoroughly. Then add 150 mils of a mixture of ether, 2 volumes, and chloroform, 1 volume, followed by 5 mils of ammonia water. Shake the mixture vigorously every ten minutes during half an hour, and when the dregs have settled decant 100 mils of the clear liquid, representing 2 Gm. of the Extract. Proceed as directed under *Belladonnæ Radix*, seventh line of the Assay, modifying the process there given by dissolving the alkaloidal residue in 10 mils of tenth-normal sulphuric acid V.S. instead of 5 mils.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 36.4 milligrammes of the alkaloids of nux vomica.

N. F. Preparations.—Pilulæ Aloes et Podophylli Compositæ; Pilulæ Ferri, Quininæ, Aloes et Nucis Vomicæ; Pilulæ Laxativæ Post Partum.

Average dose.—¼ grain (0.015 Gm.).

EXTRACTUM OPII. U. S. Extract of Opium

[Ext. Opii. Powdered Extract of Opium Opii Extractum, P. I.]

Extract of Opium yields not less than 19.5 per cent. nor more than 20.5 per cent. of anhydrous morphine. One Gm. of the Extract represents about 2 Gm. of opium.

	Metric	Old form
***Opium**, cut in small pieces	**100 Gm.**	3 oz. av. 231 gr.
Starch, dried at 100° C. (212° F.),		
Water, each, a sufficient quantity.		

Macerate the opium with 300 mils [old form about 10 fl. oz.] of hot water until softened, then rub to a smooth paste. Add to this 100 Gm. [old form about 3½ oz. av.] of clean, white sand and mix thoroughly. Transfer the mixture to a percolator and allow the percolation to proceed, gradually adding water until the opium is exhausted. Evaporate the percolate to dryness in a shallow evaporating dish, on a water bath, reduce the product to a fine powder and weigh it.

Assay a portion of this product as directed below, and, from the alkaloidal content thus determined, ascertain by calculation the amount of

anhydrous morphine in the remainder of the powder and add to this enough of the dried starch to make the finished Extract contain 20 per cent. of anhydrous morphine. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

Assay.—Dissolve 4 Gm. of Extract of Opium in 5 mils of distilled water, add gradually, with constant stirring, 25 mils of distilled water, filter, and wash the filter and residue with sufficient distilled water to make the solution measure exactly 50 mils. Then proceed as directed under *Opium*, sixteenth line of the Assay.

The morphine obtained represents 2 Gm. of Extract of Opium.

Average dose.—½ grain (0.03 Gm.).

EXTRACTUM PHYSOSTIGMATIS. U. S. Extract of Physostigma [Ext. Physostig. Powdered Extract of Physostigma]

Extract of Physostigma yields not less than 1.7 per cent. nor more than 2.3 per cent. of the alkaloids of physostigma. One Gm. of the Extract represents about 13 Gm. of physostigma.

	Metric	Old form
***Physostigma**, in No. 60 powder	1000 Gm.	32 oz. av.
Tartaric Acid	5 Gm.	70 gr.
Purified Petroleum Benzin,		
Starch, dried at 100° C. (212° F.),		
Alcohol,		
Water, each, a sufficient quantity.		

Dissolve the tartaric acid in 1000 mils [old form 2 pints] of a mixture of 3 volumes of alcohol and 1 volume of water, moisten the drug with sufficient of this solution, and pack it in a cylindrical percolator; then add enough of the acidified alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding the remainder of the prepared menstruum and then a mixture of 3 volumes of alcohol and 1 volume of water until the drug is exhausted. Recover the alcohol from the percolate by distillation at as low a temperature as practicable and concentrate the remaining liquid at a temperature not exceeding 70° C. (158° F.) until the residue measures about 200 mils [old form about 6½ fl. oz.]. Transfer the residue to a flask, using a little warm menstruum, made of the same proportion of alcohol and water as before, to rinse the still, and add the rinsing to the residue in the flask. Then add 100 mils [old form about 3¼ fl. oz.] of water and 250 mils [old form 8 fl. oz.] of purified petroleum benzin and shake the mixture thoroughly for several minutes. Allow the liquids to separate and decant the benzin layer as closely as possible; again add to the residue 200 mils [old form about 6½ fl. oz.] of purified petroleum benzin, agitate, and, after allowing the liquids to separate, decant the benzin layer as before and reject the benzin solutions.

Transfer the residue to a shallow evaporating dish, rinse the separator with a little of the warm menstruum, add the rinsings to the residue in the dish and evaporate it to pilular consistence at a temperature not exceeding 70° C. (158° F.). Now add 20 Gm. [old form 280

grains] of the dried starch, thoroughly incorporate it, set the extract aside in a current of warm air until dry, then reduce the product to a fine powder and weigh it.

Assay a portion of this product as directed below, and, from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloids in the remainder of the powder and add to this enough of the dried starch to make the finished Extract contain 2 per cent. of the alkaloids of physostigma. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

Assay.—Introduce 3 Gm. of Extract of Physostigma into a 250-mil flask, add 10 Gm. of washed sand and mix thoroughly. Then add 150 mils of ether and proceed as directed under *Physostigma*, second line of the Assay.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 27.52 milligrammes of the alkaloids of physostigma.

Average dose.—$\frac{1}{8}$ grain (0.008 Gm.).

EXTRACTUM RHEI. U. S. Extract of Rhubarb

[Ext. Rhei POWDERED EXTRACT OF RHUBARB]

One Gm. of the Extract represents 2 Gm. of rhubarb.

	Metric	Old form
***Rhubarb**, in No. 40 powder	**1000 Gm.**	32 oz. av.
Magnesium Oxide	**50 Gm.**	1 oz. av. 262 gr.
Starch, dried at 100° C. (212° F.),		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**500 Gm.**	16 oz. av.

Moisten the drug with sufficient of a mixture of 4 volumes of alcohol and 1 volume of water, pack it in a cylindrical percolator and add enough of this menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum of the same proportion of alcohol and water as before until the drug is exhausted. Recover the alcohol from the percolate by distillation at as low a temperature as practicable, and continue distillation until a residue of syrupy consistence remains in the still. Transfer this to a shallow dish, rinse the still with a little warm menstruum, add the rinsings to the residue in the dish, and evaporate the mixture to dryness, with frequent stirring, at a temperature not exceeding 70° C. (158° F.). Weigh the dry extract and add the magnesium oxide and sufficient of the dried starch to make the product weigh 500 Gm. [old form 16 oz. av.]. Reduce the mixture to a fine powder, mix thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

Average dose.—4 grains (0.25 Gm.).

EXTRACTUM STRAMONII. U. S. Extract of Stramonium

[Ext. Stramon.]

Extract of Stramonium yields not less than 0.9 per cent. nor more

than 1.1 per cent. of the alkaloids of stramonium. One Gm. of the Extract represents about 4 Gm. of stramonium.

Pilular Extract of Stramonium

	Metric	Old form
***Stramonium**, in No. 30 powder.....	**1000 Gm.**	**32 oz. av.**
Glucose,		
Alcohol,		
Water, each, a sufficient quantity.		

Moisten the powder with sufficient of a mixture of 3 volumes of alcohol and 1 volume of water and pack it in a cylindrical percolator; then add enough of this menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum of the same strength, until the drug is exhausted. Recover the alcohol from the percolate by distillation, and evaporate the residue with frequent stirring, at a temperature not exceeding 70° C. (158° F.), to a pilular consistence. Mix the mass thoroughly and weigh it.

Assay a portion of this extract as directed below, and, from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloids in the remainder of the mass and to this add enough glucose to make the finished Extract contain 1 per cent. of the alkaloids of stramonium. Mix thoroughly.

Assay.—Proceed as directed under *Extractum Belladonnæ Foliorum* (Pilular), using 2 Gm. of Pilular Extract of Stramonium.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 28.92 milligrammes of the alkaloids of stramonium.

U. S. P. Preparation.—Unguentum Stramonii (from Pilular Extract).

Powdered Extract of Stramonium

	Metric	Old form
***Stramonium**, in No. 40 powder.....	**1000 Gm.**	**32 oz. av.**
Magnesium Oxide	**20 Gm.**	**280 gr.**
Starch, dried at 100° C. (212° F.),		
Alcohol, each, a sufficient quantity.		

Moisten the drug with sufficient alcohol and pack it in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed very slowly, adding alcohol as required. Reserve the first 1000 mils [old form 2 pints] of percolate and continue the percolation until the second percolate measures 1000 mils [old form 2 pints] or until the drug is exhausted. Transfer the second percolate to a suitable apparatus and distil off the alcohol, at as low a temperature as practicable, until a residue measuring about 100 mils [old form about 3¼ fl. oz.] remains, then add the reserved percolate and continue distillation until the residue in the still is of syrupy consistence.

Transfer this residue to a shallow evaporating dish, rinse the flask or still with a small quantity of warm alcohol, and add the rinsing to

the contents of the dish. Evaporate this to a soft extract, with frequent stirring, at a temperature not exceeding 70° C. (158° F.). Then add 50 Gm. [old form 1 oz. av. 262 grains] of the dried starch and continue the heating at the same temperature, with frequent stirring, until the mass is nearly dry. Now add the magnesium oxide, thoroughly incorporate it, and set the product aside in a current of warm air, until thoroughly dry. Reduce the product to a fine powder and weigh it.

Assay a portion of this product as directed below, and, from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloids in the remainder of the powder and add to this enough dried starch to make the finished Extract contain 1 per cent. of the alkaloids of stramonium. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

Assay —Proceed as directed under *Extractum Belladonnæ Foliorum* (Powdered), using 3 Gm. of Powdered Extract of Stramonium.

Each mil of tenth-normal sulphuric acid V.S. consumed corresponds to 28.92 milligrammes of the alkaloids of stramonium.

Average dose.—1/6 grain (0.01 Gm.).

The pilular Extract of Stramonium is best adapted for making the ointment and in pills. The powdered extract is also official and is more convenient than the pilular form in preparing capsules or other mixtures of powders.

EXTRACTUM SUMBUL. U. S. Extract of Sumbul [Ext. Sumbul]

	Metric	Old form
***Sumbul,** in No. 30 powder	**1000 Gm.**	32 oz. av.
Alcohol,		
Water, each, a sufficient quantity.		

Moisten the powder with sufficient of a mixture of 4 volumes of alcohol and 1 volume of water and pack it in a cylindrical percolator; then add enough of this menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum of the same strength until the drug is exhausted. Recover the alcohol from the percolate by distillation and evaporate the residue with frequent stirring, at a temperature not exceeding 70° C. (158° F.), to a pilular consistence.

Average dose.—4 grains (0.25 Gm.).

EXTRACTUM TARAXACI. U. S. Extract of Taraxacum [Ext. Tarax.]

	Metric	Old form
***Taraxacum,** in No. 30 powder	**1000 Gm.**	32 oz. av.
Alcohol,		
Water, each, a sufficient quantity.		

Mix 125 mils [old form 4 fl. oz.] of alcohol with 875 mils [old form 28 fl. oz.] of water, and, having moistened the powder with a portion

of the mixture, pack it in a cylindrical percolator, then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed, gradually adding menstruum of the same strength until the drug is exhausted. Recover the alcohol from the percolate by distillation and evaporate the residue with frequent stirring, on a water bath, to a pilular consistence.

Average dose.—15 grains (1 Gm.).

EXTRACTUM VIBURNI PRUNIFOLII. U. S. Extract of Viburnum Prunifolium

[Ext. Viburn. Prun. Powdered Extract of Viburnum Prunifolium]

1 Gm. of the Extract represents 5 Gm. of viburnum prunifolium.

	Metric	Old form
*Viburnum Prunifolium, in No. 30 powder	1000 Gm.	30 oz. av.
Magnesium Oxide	5 Gm.	68 gr.
Starch, dried at 100° C. (212° F.),		
Diluted Alcohol, each, a sufficient quantity,		
To make	200 Gm.	6 oz. av.

Moisten the powder with sufficient diluted alcohol and pack it in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, adding diluted alcohol as required until the viburnum prunifolium is exhausted. Recover the alcohol from the percolate by distillation at as low a temperature as practicable and evaporate the residue to a soft extract in a shallow dish on a water bath, at a temperature not exceeding 70° C. (158° F.). Add the magnesium oxide, incorporate it thoroughly, spread the extract on glass plates and dry it by exposure to currents of warm air. Reduce the extract to a fine powder, weigh it, and add sufficient of the dried starch to make the finished product weigh 200 Gm. [old form 6 oz. av.]. Mix the powder thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

Average dose.—8 grains (0.5 Gm.).

EXTRACTUM ALOES. N. F. Extract of Aloes

(U.S.P. VIII)

[Ext. Aloes. Powdered Extract of Aloes]

One Gm. of the Extract represents 2 Gm. of aloes.

	Metric	Old form
Aloes, in No. 20 powder	1000 Gm.	32 oz. av.
Boiling Water	10000 mils	20 pints
Starch, dried at 100° C. (212° F.), a sufficient quantity,		
To make	500 Gm.	16 oz. av.

Mix the aloes with the boiling water in a suitable vessel, stir constantly until the particles of aloes are thoroughly disintegrated, and allow the mixture to stand for twelve hours. Then pour off the clear liquid, strain the residue, and evaporate the mixed liquids to dryness on a water bath or steam bath. Reduce the extract to a fine powder, and, if necessary, add a sufficient quantity of the thoroughly dried starch to make the product weigh 500 Gm. [old form 16 oz. av.]. Mix the powders thoroughly, pass the powdered extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

N. F. Preparations.—Pilulæ Antiperiodicæ; Tinctura Antiperiodica.

Average dose.—2 grains (0.125 Gm.).

EXTRACTUM CINCHONÆ. N. F. Extract of Cinchona [Ext. Cinchon.]

Extract of Cinchona yields not less than 22 per cent. nor more than 26 per cent. of the combined alkaloids of cinchona.

	Metric	Old form
Cinchona, in No. 60 powder	**1000 Gm.**	32 oz. av.
Glucose,		
Alcohol,		
Water, each, a sufficient quantity.		

Moisten the ground drug with 350 mils [old form about 11 fl. oz.] of a menstruum made by mixing 3000 mils [old form 6 pints] of alcohol and 1000 mils [old form 2 pints] of water, introduce the moistened drug into a percolator and allow it to stand, well covered, for several hours. Then pack it firmly, pour on sufficient menstruum to saturate the powder and leave a stratum above it, and when the liquid begins to drop from the percolator close the lower orifice, and, having covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, first pouring on the remainder of the menstruum prepared above and following this with diluted alcohol until the percolate measures 4000 mils [old form 8 pints].

Reserve the first 900 mils [old form about 28¾ fl. oz.] of the percolate, evaporate the remainder, in a porcelain or enameled dish, at a temperature not exceeding 80° C. (176° F.), to 100 mils [old form about 3¼ fl. oz.], add the reserved portion, and again evaporate at or below the specified temperature until of pilular consistence.

Assay 3 Gm. of this extract, as directed below, and, from the result thus obtained, ascertain by calculation the amount of alkaloids in the remainder of the product and add enough glucose to make the finished Extract contain 24 per cent. of the combined alkaloids of cinchona.

Assay.—Dissolve 3 Gm. of Extract of Cinchona in 10 mils of a mixture of 3 parts of alcohol and 2 parts of water, and, having added 5 Gm. of purified sawdust (see Reagents, Chapter LXII), evaporate the mixture to dryness. Then transfer it to a bottle of about 500 mils capacity, add 300 mils of a mixture of 2 volumes of ether and 1 volume of chloroform, rinse the dish with 10 mils of ammonia water, added in portions, and mix the rinsings with the ethereal solution. Shake the mixture at intervals during 12 hours, allow it to settle and decant 200 mils of the clear fluid, representing 2 Gm. of the extract. Then proceed as directed under *Fluidextractum Cinchonæ Aquosum* and multiply the weight of alkaloids obtained by 50 to obtain the per cent. present in the samples assayed.

Average dose.—4 grains (0.25 Gm.).

EXTRACTUM CONII. N. F. Extract of Conium [Ext. Conii]

Extract of Conium yields not less than 1.8 per cent. nor more than 2.2 per cent. of coniine.

	Metric	Old form
Conium, in No. 40 powder	**1000 Gm.**	32 oz. av.
Diluted Hydrochloric Acid	**3 mils**	46 min.
Glucose,		
Diluted Alcohol, each, a sufficient quantity.		

Moisten the powder with 300 mils [old form about 9½ fl. oz.] of diluted alcohol and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the conium is exhausted. Reserve the first 900 mils [old form 28¾ fl. oz.] of the percolate, add the diluted hydrochloric acid to the remainder, and evaporate it, at a temperature not exceeding 50° C. (122° F.), to 100 mils [old form 3¼ fl. oz.]; mix this with the reserved portion in a porcelain dish, and evaporate at or below 50° C. (122° F.) to a pilular consistence.

Assay 2 Gm. of this extract, as directed below, and, from the result thus obtained, ascertain by calculation the amount of coniine in the remainder of the product and add enough glucose to make the finished extract contain 2 per cent. of coniine.

Assay.—Weigh accurately 2 Gm. of Extract of Conium and mix it intimately in a flask of about 50 mils capacity with 2 mils of diluted hydrochloric acid and 8 mils of distilled water. Shake this mixture thoroughly with 20 mils of purified petroleum benzin, allow the liquids to separate, and decant the benzin as closely as possible. Add a second portion of the benzin, shake well, and decant as before. Repeat the extraction with purified petroleum benzin until the washings are nearly colorless and are free from fat, and reject the benzin washings. Then add to the aqueous liquid an excess of potassium carbonate, to render it alkaline, and extract the alkaline solution by shaking it with successive portions of purified petroleum benzin until the alkaloid is all removed, as shown by shaking 5 mils of the last washing with 1 mil of diluted hydrochloric acid and adding a drop of iodine T.S. to the acid solution, when no precipitate should form in the acid liquor. Filter the benzin solution into a wide-mouthed flask or beaker and wash the funnel and filter with a little of the benzin. Then add 10 mils of tenth-normal sulphuric acid V.S. and evaporate off the benzin at a gentle heat, with frequent stirring. Titrate the acid solution with fiftieth-normal potassium hydroxide V.S., using cochineal T.S. or methyl red T.S. as indicator, and calculate the amount of coniine present, using the factor 0.0127 for the tenth-normal sulphuric acid V.S. consumed by the alkaloid and multiplying the result by 50 to obtain the percentage of coniine in the extract.

Average dose.—½ grain (0.03 Gm.).

EXTRACTUM ERGOTÆ AQUOSUM. N. F. Aqueous Extract of Ergot [Ext. Ergot. Aq. Ergotin, P. I].

	Metric	Old form
Ergot, in No 30 powder	**200 Gm.**	8 oz. av.
Alcohol	**100 mils**	4 fl. oz.
Chloroform Water, a sufficient quantity.		

Moisten the ergot with 400 mils [old form 1 pint] of chloroform water and allow it to stand in a closely-covered vessel for twenty-four hours, then transfer it to a cylindrical percolator, pack the drug lightly, and

percolate with chloroform water, regulating the flow to not over 20 drops per minute, until the percolate measures 1000 mils [old form 40 fl. oz.]. Evaporate the percolate in a tared dish on a water bath, at a moderate temperature, until reduced to 100 Gm. [old form 4 oz. av.], and, when cold, incorporate the alcohol and allow the mixture to stand in a tightly-covered or closed vessel during three days. Then filter the liquid, and evaporate the filtrate on a water bath, at a temperature not exceeding 50° C. (122° F.), to a pilular consistence.

Average dose.—3 grains (0.2 Gm.).

EXTRACTUM EUONYMI. N. F. Extract of Euonymus
(U.S.P. VIII)

[Ext. Euonymi Powdered Extract of Euonymus]

One Gm. of the Extract represents 4 Gm. of euonymus.

	Metric	Old form
Euonymus, in No. 40 powder	**1000 Gm.**	32 oz. av.
Alcohol,		
Water,		
Starch, dried at 100° C. (212° F.), each, a sufficient quantity,		
To make	**250 Gm.**	8 oz. av.

Moisten the drug with sufficient of a mixture of 4 volumes of alcohol and 1 volume of water and pack it firmly in a cylindrical percolator; then add enough of the menstruum, using the same proportion of alcohol and water as before, to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, adding the menstruum as required, until the drug is practically exhausted. Recover the alcohol from the percolate by distillation and evaporate the residue to dryness, with frequent stirring, at a temperature not exceeding 70° C.(158° F.). Reduce the extract to a fine powder, weigh it, and add sufficient of the dried starch to make the product weigh 250 Gm. [old form 8 oz. av.]. Mix thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

Average dose.—2 grains (0.125 Gm.).

Caution.—It has been stated that the absorption of Euonymus in the gastro-intestinal tract is uncertain and irregular. To avoid an accumulation of the drug or toxic action, the physician should carefully guard the dosage and determine in each case the tolerance of the patient.

EXTRACTUM FERRI POMATUM. N. F. Ferrated Extract of Apples

[Ext. Ferr. Pomat. Ferri Malas Crudus Crude Malate of Iron]

	Metric	Old form
Reduced Iron	**40 Gm.**	2 oz. av.
Fresh Apple Juice	**1000 Gm.**	50 oz. av.
Water, a sufficient quantity.		

Mix the fresh apple juice with the iron in an enameled or porcelain vessel, and apply the heat of a water bath, until no more gas is given off, adding a little water from time to time to make up any loss by evaporation. Dilute the liquid with water to make 1000 Gm. [old form 50 oz. av.] and set it aside for a few days. Then filter, and evaporate the filtrate on a water bath in an enameled or porcelain vessel to the consistence of a pilular extract.

N. F. Preparation.—Tinctura Ferri Pomata.

Average dose.—10 grains (0.65 Gm.).

EXTRACTUM HÆMATOXYLI. N. F. Extract of Hematoxylon
(U.S.P. VIII)
[Ext. Hæmotox.]

	Metric	Old form
Hematoxylon, rasped	**1000 Gm.**	32 oz. av.
Water	**10000 mils**	20 pints

Macerate the hematoxylon with the water for forty-eight hours. Then boil the mixture (avoiding the use of metallic vessels) until one-half of the water has evaporated; strain the decoction while hot and evaporate the strained liquid to dryness.

Average dose.—15 grains (1 Gm.).

EXTRACTUM IGNATIÆ. N. F. Extract of Ignatia
[Ext. Ignat. Powdered Extract of Ignatia]

Extract of Ignatia yields not less than 5.4 per cent. nor more than 6.6 per cent. of the combined alkaloids of ignatia.

	Metric	Old form
Ignatia, in No. 40 powder	**1000 Gm.**	32 oz. av.
Alcohol,		
Water,		
Starch, dried at 100° C. (212° F.), each, a sufficient quantity.		

Mix 3000 mils [old form 6 pints] of alcohol with 1000 mils [old form 2 pints] of water, and, having moistened the powder with 500 mils [old form 1 pint] of the mixture, pack it firmly in a conical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding the remainder of the menstruum and continuing the percolation with a mixture of alcohol and water in the same proportions as before, until the drug is practically exhausted. Recover the alcohol from the percolate, evaporate the residue to dryness at a temperature not exceeding 100° C. (212° F.), and weigh the product.

Assay 3 Gm. of this extract, as directed below, and, from the result thus obtained, ascertain by calculation the amount of alkaloids in the remainder of the product and add enough starch, previously dried at 100° C. (212° F.), to make the finished Extract contain 6 per cent. of the combined alkaloids of ignatia.

Assay.—Proceed as directed under *Ignatia*, using 3 Gm. of Extract of Ignatia.

Average dose.—½ grain (0.03 Gm.).

EXTRACTUM JALAPÆ. N. F. Extract of Jalap
[Ext. Jalap.]

	Metric	Old form
Jalap, in No. 60 powder	**1000 Gm.**	32 oz. av.
Alcohol, a sufficient quantity.		

Moisten the ground drug with 350 mils [old form about 11 fl. oz.] of alcohol, place the moistened drug in a percolator, and allow it to stand, well covered, for several hours. Then pack it firmly, pour on alcohol to saturate the powder and leave a stratum above it, and, when the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding alcohol until the percolate measures 3000 mils [old form 6 pints].

Reserve the first 900 mils [old form 28¾ fl. oz.] of the percolate, evaporate the remainder, in a porcelain or enameled dish, at a temperature not exceeding 50° C. (122° F.), to 100 mils [old form 3¼ fl. oz.], add the reserved portion and evaporate at or below the above mentioned temperature until an extract of pilular consistence remains.

Average dose.—15 grains (1 Gm.).

EXTRACTUM KRAMERIÆ. N. F. Extract of Krameria
(U.S.P. VIII)

[Ext. Kramer. Powdered Extract of Krameria]

One Gm. of the Extract represents 4 Gm. of krameria.

	Metric	Old form
Krameria, in No. 30 powder	**1000 Gm.**	32 oz. av.
Starch, dried at 100° C. (212° F.),		
Water, each, a sufficient quantity,		
To make	**250 Gm.**	8 oz. av.

Moisten the drug thoroughly with water and pack it in a conical glass percolator, and gradually pour water upon it, until the infusion passes but slightly imbued with the taste of the drug. Heat the percolate to the boiling point, strain, and evaporate the strained liquid to dryness, by means of a water bath, at a temperature not exceeding 70° C. (158° F.). Reduce the extract to a fine powder, and add sufficient starch, previously dried at 100° C. (212° F.), to make the product weigh 250 Gm. [old form 8 oz. av.]. Mix the powders thoroughly, pass the Extract through a fine sieve and transfer it to small, wide-mouthed bottles and stopper them tightly.

Average dose.—8 grains (0.5 Gm.).

EXTRACTUM LEPTANDRÆ. N. F. Extract of Leptandra
(U.S.P. VIII)

[Ext. Leptand. Powdered Extract of Leptandra]

One Gm. of the Extract represents 4 Gm. of leptandra.

	Metric	Old form
Leptandra, in No. 30 powder	**1000 Gm.**	32 oz. av.
Starch, dried at 100° C. (212° F.),		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**250 Gm.**	8 oz. av

Moisten the powdered drug with sufficient of a mixture of 3 volumes of alcohol and 1 volume of water, and macerate it in a closed vessel for twenty-four hours. Then pack in a cylindrical percolator and gradually percolate with a menstruum of alcohol and water made in the same proportion as before, until the drug is practically exhausted. Recover the alcohol and evaporate the residue to dryness, on a water bath or steam bath, at a temperature not exceeding 70° C. (158° F.). Reduce the extract to a fine powder and add sufficient starch, previously dried at 100° C. (212° F.), to make the product weigh 250 Gm. [old form 8 oz. av.]. Mix the powders thoroughly, pass the Extract through a fine sieve and transfer it to small, wide-mouthed bottles and stopper them tightly.

N. F. Preparation.—Pilulæ Catharticæ Vegetabiles.

Average dose.—4 grains (0.25 Gm.).

EXTRACTUM PODOPHYLLI. N. F. Extract of Podophyllum [Ext. Podophyl.]

	Metric	Old form
Podophyllum, in No. 60 powder	**1000 Gm.**	32 oz. av.
Alcohol,		
Water, each, a sufficient quantity.		

Moisten the ground drug with 300 mils [old form 9½ fl. oz.] of a menstruum consisting of a mixture of 4 volumes of alcohol and 1 volume of water, place the moistened drug in a percolator and allow it to stand, well covered, for several hours. Then pack it firmly, pour on menstruum to saturate the powder and leave a stratum above it, and, when the liquid begins to drop, close the lower orifice, closely cover the percolator, and macerate for forty-eight hours. Then allow the percolation to proceed, slowly pouring on menstruum of the same proportions of alcohol and water as before until the percolate measures 3000 mils [old form 6 pints].

Reserve the first 900 mils [old form 28¾ fl. oz.] of the percolate, evaporate the remainder in a porcelain or enameled dish, at a temperature not exceeding 50° C. (122° F.), to 100 mils [old form 3¼ fl. oz.], add the reserved portion, and evaporate at or below the above mentioned temperature until an extract of pilular consistence remains.

Average dose.—¼ grain (0.015 Gm.).

EXTRACTUM QUASSIÆ. N. F. Extract of Quassia

(U.S.P. VIII)

[Ext. Quas. Powdered Extract of Quassia]

One Gm. of the Extract represents 10 Gm. of quassia.

	Metric	Old form
Quassia, in No. 20 powder	**1000 Gm.**	30 oz. av.
Water,		
Starch, recently dried at 100° C. (212° F.), and in fine powder, each, a sufficient quantity,		
To make	**100 Gm.**	3 oz. av.

Moisten the powdered drug with 400 mils [old form about 12 fl. oz.] of water, pack it firmly in a conical percolator, and gradually pour water upon it until the percolate passes but slightly imbued with bitterness. Reduce the liquid to three-fourths of its bulk by boiling, and strain, then evaporate the liquid to dryness in a water bath and add enough starch, previously dried at 100° C. (212° F.), to make the product weigh 100 Gm. [old form 3 oz. av.]. Mix the powders thoroughly, pass the powdered Extract through a fine sieve, transfer it to small, wide-mouthed bottles, and stopper them tightly.

Average dose.—1 grain (0.06 Gm.).

Resinæ U. S. *Resins*

The official resins are solid preparations consisting chiefly of the resinous principles from vegetable bodies. The officially prepared resins differ from alcoholic extracts in the fact that the latter contain all the principles in the drug which alcohol is capable of dissolving, while the resins contain only those principles which are soluble in alcohol and are insoluble in water. It is obvious that the resins prepared from those drugs which owe their activity exclusively to resinous principles, which are insoluble in water, are stronger preparations than the alcoholic extracts from such drugs. *Four* resins are official in the U. S. P. IX:

Official Resins

Name	Preparation
Resina	By-product, the residue left after distilling the volatile oil from the concrete oleoresin obtained from Pinus Palustris and other species of Pinus
Jalapæ	Percolate Jalap, in No. 60 powder, with Alcohol until the tincture ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol until the residue in the still weighs 250 Gm. and add the concentrated tincture to 3000 mils of water, collect, wash the precipitate with two portions of 1000 mils each, of hot water, drain and dry the precipitate
Podophylli	Percolate Podophyllum, in No. 60 powder, with Alcohol until the tincture ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol until the residue is reduced to the consistence of a thin syrup and add the concentrated tincture slowly and with constant stirring to 1000 mils of water, cooled to below 10° C. (50° F.), and to which 10 mils of Hydrochloric Acid has been added. Collect, wash the precipitate with two portions of 1000 mils each, of cold water, drain, and dry the precipitate
Scammonii	Percolate the Scammony Root, in No. 30 powder, with Alcohol until the tincture ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol until the residue is reduced to the consistence of thin syrup, and pour this slowly and with constant stirring into 1000 mils of hot water, wash the precipitate with two portions of 1000 mils each of hot water, and dry the Resin on a water bath

RESINA. U. S. Rosin
[Resin. Colophony]

The residue left after distilling the volatile oil from the concrete oleoresin obtained from *Pinus palustris* Miller and from other species of *Pinus* (Fam. *Pinaceæ*).

Official Description.—Usually in sharp, angular, translucent, amber-colored fragments, frequently covered with a yellow dust, brittle at the ordinary temperature; fracture shiny and shallow-conchoidal.

Odor, Taste and Reaction.—Odor and taste slightly terebinthinate; its alcoholic solution is acid to litmus.

Solubility.—Freely soluble in alcohol, ether, benzene, glacial acetic acid, or fixed or volatile oils; also dissolved by dilute solutions of the fixed alkali hydroxides.

Specific Gravity.—1.07 to 1.09 at 25° C. (77° F.).

Tests for Identity.—It is easily fusible and burns with a dense yellowish smoke. Incinerate about 2 Gm. of Rosin; not more than 0.05 per cent. of ash remains.

The acid number of Rosin is not less than 150 (see Chapter LXII, Test No. 10).

U. S. P. Preparations.—Ceratum Cantharidis; Ceratum Resinæ; Emplastrum Resinæ; Linimentum Terebinthinæ (from Rosin Cerate).

RESINÆ JALAPÆ. U. S. Resin of Jalap
[Res. Jalap.]

	Metric	Old form
Jalap, in No. 60 powder	**1000 Gm.**	**32 oz. av.**
Alcohol,		
Water, each, a sufficient quantity.		

Moisten the powder with 500 mils [old form 1 pint] of alcohol, and pack it in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding alcohol, until the percolate ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol until the percolate is reduced in weight to 250 Gm. [old form 8 oz. av.] and add the latter slowly, with constant stirring, to 3000 mils [old form 6 pints] of water. When the precipitate has subsided, decant the supernatant liquid, and wash the precipitate twice, by decantation, with fresh portions of 1000 mils [old form 2 pints] each of hot water. After having drained off all of the liquid, transfer the Resin to a porcelain dish and heat it to dryness on a water bath.

Official Description.—In yellow to brown colored masses or fragments, breaking with a resinous, glassy fracture and translucent at the edges, or as a yellowish-gray to yellowish-brown powder.

Odor, Taste, and Reaction.—It has a slight, peculiar odor, and a somewhat acrid taste. It is permanent in the air. Its alcoholic solution is faintly acid to litmus.

Solubility.—Soluble in alcohol in all proportions; insoluble in carbon disulphide, benzene, or fixed or volatile oils.

Impurities and Tests for Impurities.—Add 1 Gm. of the powdered Resin to 10 mils of chloroform in a stoppered flask and shake the mixture occasionally during one hour. Then filter, evaporate the filtrate in a tared dish and dry the residue to constant weight at 100° C. (212° F.); it weighs not more than 0.3 Gm.

Rosin, Orizaba, or other Resins.—Add 1 Gm. of the powdered Resin to 10 mils of ether in a stoppered flask and shake the mixture occasionally during one hour. Then filter, evaporate the filtrate in a tared dish and dry the residue to constant weight at 100° C. (212° F); it weighs not more than 0.12 Gm.

Rosin, Guaiac, or other Resins.—It is slowly but completely soluble in 5 times its weight of ammonia water, and the solution does not become gelatinous on standing. When this solution is acidified with hydrochloric acid, only a slight turbidity appears.

Water.—When heated at 100° C. (212° F.) no material loss in weight is observed.

Soluble Impurities—Aloin.—When triturated with distilled water, the latter does not become colored, none of the Resin dissolves, and the water does not have a bitter taste.

Guaiac.—Shake 0.02 Gm. of Resin of Jalap with 5 mils of ether, filter and evaporate the ethereal filtrate on a piece of filter paper; no greenish-blue color is produced by the application of a drop of ferric chloride T.S. to the filter paper.

Acid Resins.—One Gm. of the Resin when dissolved in 50 mils of alcohol, containing 1 mil of phenolphthalein T.S., requires not more than 0.5 mil of half-normal alcoholic potassium hydroxide V.S. to produce a red color.

Rosin.—Dissolve 0.02 Gm. of Resin of Jalap in 2 mils of glacial acetic acid and add a few drops of sulphuric acid; the mixture does not acquire a pink color.

U. S. P. Preparation.—Pilulæ Catharticæ Compositæ.

Average dose.—2 grains (0.125 Gm.).

RESINA PODOPHYLLI. U. S. Resin of Podophyllum

[Res. Podoph. PODOPHYLLIN]

	Metric	Old form
Podophyllum, in No. 60 powder	**1000 Gm.**	32 oz. av.
Hydrochloric Acid	**10 mils**	2½ fl. dr.
Alcohol,		
Water, each, a sufficient quantity.		

Moisten the powder with 500 mils [old form 1 pint] of alcohol and pack it in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the percolate ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol until the percolate is reduced to the consistence of a thin syrup, and pour this slowly, with constant stirring, into 1000 mils [old form 2 pints] of water, mixed with the hydrochloric acid and cooled to a temperature below 10° C. (50° F.). When the precipitate has subsided, decant the supernatant liquid, and wash the precipitate twice by decantation with fresh portions of 1000 mils [old form 2 pints] of cold water. Spread it in a thin layer upon a strainer and dry the Resin by exposure to the air, in a cool place, protected from the light. Should it coalesce during the drying or aggregrate into lumps having a glossy surface, break it into pieces, and powder it in a mortar.

Preserve it in well-closed containers, protected from light.

Official Description.—An amorphous powder varying in color from light brown to greenish-yellow, turning darker when subjected to a temperature exceeding 25° C. (77° F), or when exposed to light.

Odor, Taste, and Reaction.—It has a slight, peculiar odor and a faintly bitter taste. It is very irritating to the eyes and to mucous membrane. Its alcoholic solution is faintly acid to litmus.

Solubility.—Soluble in alcohol with only a slight opalescence.

Tests for Identity.—Not less than 75 per cent. of Resin of Podophyllum is soluble in ether and not less than 65 per cent. is soluble in chloroform.

A hot aqueous solution of Resin of Podophyllum deposits most of its contents on cooling, and if the cooled liquid is filtered, the filtrate has a bitter taste, and turns brown upon the addition of a few drops of ferric chloride T.S.

It is soluble in potassium or sodium hydroxide T.S., forming a deep yellow liquid, which gradually becomes darker on standing, and from which the Resin is reprecipitated by acids.

Impurities and Tests for Impurities.—(Difference from Resin obtained from *Podophyllum Emodi.*) Add 0.4 Gm. of Resin of Podophyllum to 3 mils of 60 per cent. alcohol, introduce 0.5 mil of potassium hydroxide T.S., and gently shake the mixture; it does not gelatinize.

Resin of Podophyllum yields not more than 1.5 per cent. of ash.

N. F. Preparations.—Pilulæ Aloes et Podophylli Compositæ; Pilulæ Aloes, Hyoscyami et Podophylli; Pilulæ Aloini Compositæ; Pilulæ Catharticæ Vegetabiles; Pilulæ Colocynthidis et Podophylli; Pilulæ Laxativæ Post Partum.

Average dose.—1/6 grain (0.01 Gm.).

RESINA SCAMMONIÆ. U. S. Resin of Scammony

[Res. Scamm.]

	Metric	Old form
Scammony Root, in No. 30 powder	**1000 Gm.**	32 oz. av.
Alcohol,		
Water, each, a sufficient quantity.		

Moisten the scammony root with sufficient alcohol, pack it in a cylindrical percolator, then add enough alcohol to saturate the powder and

leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the percolate ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol until the percolate is reduced to the consistence of thin syrup, and pour this slowly, with constant stirring, into 1000 mils [old form 2 pints] of hot water. When the precipitate has subsided, decant the supernatant liquid, wash the precipitated Resin twice by decantation with fresh portions of 1000 mils [old form 2 pints] each of hot water and dry the Resin on a water bath.

Official Description.—It consists of brownish, translucent masses or fragments, breaking with a glossy, resinous fracture.

Odor.—Characteristic and agreeable.

Solubility.—Soluble in alcohol in all proportions.

Impurities and Tests for Impurities.—Distinction from resin of jalap and resin of false scammony. Not less than 95 per cent. is soluble in ether.

When triturated with water, it does not form an emulsion.

Ammonia water and solutions of the alkali hydroxides dissolve it with the aid of gentle heat, and from these solutions the Resin is not reprecipitated by dilute acids.

Guaiac.—Its solution in alcohol does not give a blue color with ferric chloride T.S. or with solution of hydrogen dioxide.

Rosin.—Sulphuric acid does not turn red when stirred in a porcelain dish with an equal weight of Resin of Scammony.

Resin of Scammony yields not more than 1 per cent. of ash.

U. S. P. Preparation.—Extractum Colocynthidis Compositum.

N. F. Preparations.—Pilulæ Aloes, Hydrargyri et Scammonii Compositæ; Pilulæ Colocynthidis Compositæ; Pilulæ Colocynthidis et Hyoscyami; Tinctura Jalapæ Composita.

Average dose.—3 grains (0.2 Gm.).

QUESTIONS ON SOLID PREPARATIONS MADE BY PERCOLATION

What are extracts? (See page 606.)
What various menstrua are used in making them?
What are inspissated juices?
By what names are such extracts called?
Why are alcoholic extracts preferred to those made from inspissated juices?
How are these juices prepared by the British Pharmacopœia of 1898?
How have extracts been prepared by the freezing process?
Do the percolates or expressed juices of drugs contain anything in addition to the active principles?
What proximate principles are most commonly present in extracts?
Which of these principles are absent when a menstruum of part alcohol is used?
What is meant by extractive?
What name was proposed for this substance by Berzelius?
Why are extracts variable in strength?
What is the Pharmacopœia's standard for the consistence of extracts?
In what respect have powdered extracts an advantage over pilular extracts?
Are unassayed extracts a reliable class of preparations?
What pharmaceutical processes are used in making extracts?
How may pilular extracts be preserved? What are powdered extracts?
How is such an extract prepared?
What purpose governs the selection of menstrua in making powdered extracts?
Why must oils be removed if present in drugs from which powdered extracts are to be made?
What precaution should be taken in preserving powdered extracts?
Why is the temperature, during evaporation, kept at the lowest possible point?
How is effective evaporation at low temperatures best accomplished?
What diluents are recommended for pilular extracts? Which for powdered extracts?
What are "abstracts"?

How many official extracts are there?
How many extracts are made with an alcoholic menstruum? Name them.
How many official extracts are made with an aqueous menstruum? Name them.
Which one is percolated with water containing five per cent. of water of ammonia?
Which by mixing extracts with aromatics?
How many pilular extracts are official? How many powdered extracts?
State the alkaloidal standard adopted by the U. S. P. IX for the following extracts: aconite, belladonna leaves, colchicum corm, hydrastis, hyoscyamus, nux vomica, opium, physostigma, stramonium, cinchona, conium, ignatia.
State the biological standard adopted for the following extracts: aconite, cannabis.
How is extract of aconite made? What is the relation of the extract to the drug? Give similar facts concerning: extract of belladonna leaves, extracts of cascara sagrada, cimicifuga, colchicum corm, colocynth, oxgall, gelsemium, hydrastis, hyoscyamus, opium, physostigma, rhubarb, stramonium, viburnum prunifolium, aloes, euonymus, krameria, leptandra, quassia.
Why are both the pilular and powdered extracts of belladonna leaves and of stramonium official?
Give the process of manufacture for extracts of cannabis, compound extract of colocynth, extracts of ergot, gentian, pure extract of glycyrrhiza, extracts of malt, nux vomica, sumbul, taraxacum, cinchona, conium, aqueous extract of ergot. What is its synonym?
Give the process for manufacturing ferrated extract of apples, extracts of hematoxylon, ignatia, jalap, podophyllum.
From what plant is extract of glycyrrhiza obtained?
How much of it should be soluble in cold water?
What are official resins? How are they prepared?
In what respect do they differ from alcoholic extracts?
How many resins are official in the U. S. P. IX? Name them.
What is rosin? State its synonym.
Give the Latin name and menstruum for resin of jalap. How is it prepared?
How may it be distinguished from other resins?
Give the Latin name and menstruum for resin of podophyllum. Resin of scammony.
How may these be distinguished?

CHAPTER XXXI

SOLID OFFICIAL PREPARATIONS MADE WITHOUT PERCOLATION

It is not the intention in this chapter to consider *in detail* the classes of solid official preparations included in the above title, because their manufacture either belongs to the domain of magistral pharmacy or is intimately connected with it. They are more appropriately treated in the final chapters of the book, because their preparation generally demands a higher degree of skill, and a more intimate knowledge of the physical properties of medicinal substances, than are necessary in making those which have been heretofore considered. For these reasons it has been the author's custom, in lecturing upon the subjects treated of in this work, to reserve the consideration of the solid official preparations made without percolation, and those which are embraced under the general term "extemporaneous," until after the student has studied the physical and chemical properties of the various substances which compose the materia medica. It is well for the student to have sufficient knowledge of these preparations to be able to define each class, so that when they are incidentally mentioned in Parts III and IV he may be able to describe the use and appearance of a powder, troche, plaster, pill, etc. If it is considered desirable to deviate from this plan, the chapters on these subjects are so constructed that the student may easily turn to them and study them out of the order given here. They will be found in Part V.

It will be well, however, in this place, in order to keep the classification in view, to enumerate them briefly. They are Pills, Tablets, Troches, Masses, Confections, Powders, Triturations, Saccharated Powders, Effervescent Salts, Oil Sugars, Suppositories, Bougies, Catheters, Pencils, Cerates, Ointments, Inunctions, Glycerogelatins, Pastes, Cataplasms, Plasters, and Papers. Among those intended for internal administration pills, troches, and tablets are largely used, and, because their preparation requires the drugs to be in the form of powder, the classes termed powders and triturations, which are dispensed extemporaneously, are grouped with them. Masses and confections are, of course, considered in connection with pills, because they are used in their preparation. Suppositories, bougies, catheters, and pencils form another classification, while cerates, ointments, inunctions, glycerogelatins, pastes, cataplasms, plasters, and papers form a natural group, being preparations that are used externally.

INDEX

VOLUME I

HEAVY BLACK FIGURES INDICATE PAGES UPON WHICH WORKING PROCESSES WILL BE FOUND

A.

Abbé disintegrator, 190
Abbreviations of U.S.P., 32
Abstracts, 610
Acacia and morphine syrup, **344**
  bark decoction, **458**
  mucilage, **353**
  syrup, **326**
Aceta, 603
Acetate, potassium and buchu, elixir, **403**
  and juniper elixir, **419**
  elixir, **419**
Acetic fluidextracts, 527
  turpentine liniment, **436**
Acetone, 214
  as solvent, 214
Acetous liquids, 301
  liquids by percolation, 603
    questions, 605
Acetum aromaticum, 603, **604**
  cantharidini, **603**
  opii, 603, **604**
  scillæ, 603, **604**
  urguinæ, **603**
Acid camphor mixture, **364**
  carbolic, glycerite, **376**
  citric, syrup, **326**
  formic, spirit, **391**
  hydriodic, syrup, **327**
  solution of mercuric nitrate, 315
  tannic, glycerite, **374**
Acids, 214
  as solvents, 214
Aconite and chloroform liniment, **434**
  extract, **618**
  fluidextract, **535**
  liniment, **431**
  tincture, **469**
Aconiti tinctura P. I., **469**
Aconitine oleate, **438**
Actæa, syrup, compound, **338**
Acts, Food and Drugs, National and State, 27
Adapters, 166
Adjuvant, elixir, **400**
Adonis fluidextract, **565**
Adrenaline hydrochloride solution, 315
Agate ware evaporating dish, 152
Airflue, 117
Albumin for clarifying, 245
Alcohol, 213
  as solvent, 213
  ethyl or grain, 119
  methyl, 119
  solidified, 121
  stoves, 119
Alcoholic liquids, 301
  percentage of fluidextracts, 528
  solutions, 301, 382
    questions, 425
Alcoholmeter, 86
  centisimal, 87
  Gay-Lussac's, 87
Alembic, 160
  principle, 171
  stills, 171
Aletris fluidextract, **565**
Alkaline mixture of rhubarb, 369
Alligation applied to pharmacy, 101
Almond, bitter, spirit, **387**
  syrup, **325**
  elixir, compound, **401**
  emulsion, **355**
  milk, **355**
Aloes and myrrh tincture, **496**
  decoction, compound, **458**
  extract, **635**
  tincture, **469**
Alsop's infusion jar, 450
Alstonia infusion, **456**
  tincture, **468**
Althæa, syrup, **335**
Alum glycerite, **374**
Aluminum grain weights, **73**
  wire weights, 73
American Dispensatory, King's, 38
Ammonia liniment, **432**
  solution, anisated, 391
  spirit, **384**
    anisated, **391**
    aromatic, **386**
    fetid, **385**
Ammoniac emulsion, **355**
Ammoniated camphor wash, **372**
  liniment of camphor, **431**
  tincture of ergot, **500**
    of guaiac, **481**
    of opium, **468**
    of quinine, **468**
    of valerian, **494**
Ammonium bromide elixir, **400**
  chloride mixture, **364**
  hypophosphite syrup, **335**
  iodide liniment, **434**
  valerate elixir, **401**
Analytical balances, 64
Ancient weights, 41
Angelica root fluidextract, **566**
Animal charcoal for decoloration, 247
Anisated solution of ammonia, **391**
  spirit of ammonia, **391**
Anise elixir, **402**
  spirit, **387**
  water, **306**
Annealing, 129
Anodyne, chloroform, **365**
  Hoffmann's, **391**
Answers to practical problems and exercises, metrology, 108
Anthracite coal, 116
Antimony wine, **514**
Antiperiodic tincture, **497**
  without aloes, **497**
Ants, spirit, **391**
Apiol, liquid, **600**
Apocynum fluidextract, **566**
Apothecaries' measures, 44
  weights, 43
Apothem, 607
Apparatus for boiling point determinations, 148
  for continuous washing, 223
  stand, 168
  vacuum, 153
Appert glass tank, 261
  glass well tube percolator, 292
Approximate measures, 45
Aqua ammoniæ, 303
  fortior, 303
  amygdalæ amaræ, 302, **306**
  anethi, 311
  anisi, 304, **306**, 311
  aurantii floris, 311
  florum, **306**
    fortior, 305, 307
  camphoræ, 304, **307**, 311
  carui, 311
  chloroformi, 302, **307**, 311
  cinnamomi, 304, **308**, 311

Aqua creosoti, 302, **308**
destillata 305, **308**, 311
sterilisata, 305, **309**,
fœniculi, 304, **309**, 311
hamamelidis, 305, **309**
laurocerasi (cherry laurel), 311
menthæ piperitæ, 304, **310**, 311
viridis, 304, **310**, 311
phagedænica flava, **372**
nigra, **372**
phenolata, N. F., 302, **311**
rosæ, 305, **310**, 311
fortior, 305, 311
sedativa, N. F. III, **372**
Aquæ, 302
aromaticæ, 305
Aqueous elixir of glycyrrhiza, **414**
of licorice, **414**
extract of ergot, **637**
fluidextract of cinchona, **571**
liquids, 301
solutions, 301, 302, 351
containing sweet or viscid substances, 317
containing sweet, viscid, or suspended substances, 301
tincture of rhubarb, **509**
Aralia fluidextract, **567**
Areometers, 83
Argentine Pharmacopœia, 26
Arnica fluidextract, **567**
root, extract, **618**
fluidextract, **534**
tincture, **468**
tincture, **470**
Aromatic camphor mixture, **364**
castor oil, **447**
elixir, **400**
of eriodictyon, **409**
of glycyrrhiza, **414**
of licorice, **414**
of yerba santa, **409**
red, **402**
fluidextract, **536**
of cascara sagrada, **541**
fluidglycerate of cascara sagrada, **592**
oil spray, **446**
spirit of ammonia, **386**
syrup, **325**
of cascara, **325**
of eriodictyon, **339**
of rhubarb, **332**
of senna, **349**
of yerba santa, **339**
tincture, **497**
of rhubarb, **490**
vinegar, **604**
waters, 305
Aromatol, 446
Arrangement of funnel in filtration, 233
Asafetida emulsion, **356**
magnesia and opium mixture, **367**
milk, **356**
tincture, **470**
Asarum, syrup, compound, **336**
Asbestos board, 149
Asclepias, fluidextract, **567**
Ash, white, wine, **517**
Aspidium oleoresin, **599**
Aspidosperma, fluidextract, **537**
Aspirator, Lux's, 240
Assay, extract of aconite, 619
belladonna leaves, pilular, 620
powdered, 621
cannabis, 621
cinchona, 636
colchicum corm, 623
conium, 627
hydrastis, 628
hyoscyamus, 628
ignatia, 639
nux vomica, 630
opium, 631
physostigma, 632
stramonium, pilular, 633
powdered, 633
fluidextract of aconite, 536
belladonna root, 539
cannabis, 540
cinchona, 543
aqueous, 571
colchicum corm, 573
seed, 544
conium, 574
digitalis, 544
guarana, 550
hydrastis, 551
hyoscyamus, 551
ipecac, 552
nux vomica, 554
pilocarpus, 554
squill, 558
stramonium, 588
processes, 35
tincture of aconite, 469
belladonna leaves, 472
cannabis, 474
cinchona, 476
compound, 477
colchicum seed, 478
deodorized opium, 488
digitalis, 478
hydrastis, 481
hyoscyamus, 482
ignatia, 503
iodine, 483
nux vomica, 486
opium, 487
physostigma, 489
squill, 492
stramonium, 492
strophanthus, 493
wine of colchicum corm, 516
seed, 516
ipecac, 517
Assayed tinctures, modification for, 463
Astringent mixture, 363
Atropine oleate, 438
sulphate solution, 315
Aurantii florum, 305
Austrian Pharmacopœia, 26
Automatic water still, Stokes', 179
Auxiliary thermometer, 129
Avoirdupois pound, 43
weights, 43, 71
origin, 42

B.

Bacteriology, 25
Balance, ball, 66
care of, 70
compound lever, 67
double beam, unequal arm, 66
for liquids, 67
hydrostatic, 78
Mohr's specific gravity, 88
prescription, 64
box, 67
torsion, 69
single beam, unequal arm, 66
testing, 61
torsion, 68
Westphal specific gravity, 89
Balanced handle spatulas, 204
Balances, analytical, 64
construction, 60
counter, 65, 67
hand, 62
prescription, 63
single beam, equal arm, 60, 62
Stansico, **63**
Ball scale, 66
Balsam, tranquillizing, **602**
Balsamum tranquillans, **602**
Baptisia fluidextract, **567**
Bark, cotton root, fluidextract, **578**
Barrel mills, 196
Bartlett's funnel, 236
Bateman's pectoral drops, **507**
Bath, glycerin, 139
oil, 139
salt water, 139
sand, 139
steam, 141
Baths, 139
Battery of pebble mills, 196
Baumé tranquille, 601
Baumé's hydrometer, 83
Bay rum, 392
Beads, Lovi's, 82
specific gravity, 82
Bearberry infusion, **456**
Beck's hydrometer, 87
Beef and iron wine, **515**
and wine, **515**
wine, **515**
and iron, **515**
Belgian Pharmacopœia, 26
Belladonna extract, green, 606
leaves, extract, **619**
tincture, **471**

Belladonna liniment, 432
root fluidextract, 539
Belladonnæ tinctura, P. I., 471
Bending glass tubes, 162
Bensemann's method for collecting fusible bodies, 128
Bent horn stirrer, 153
Benzene, 213
as solvent, 213
Benzin, 121
as solvent, 213
Benzoin tincture, 472
tincture, compound, 472
Berberis fluidextract, 568
tincture, 468
Berlinware funnels, 234
Berries, juniper, fluidextract, 587
Berzelius' alcohol lamp, 120
blowpipe, 136
Bestuscheff's tincture, 501
Betanaphthol petrox, 441
petroxolin, 441
Bismuth and ammonium citrate solution, 315
and pepsin elixir, 417
elixir, 402
glycerite, 376
magma, 370
pepsin and strychnine elixir, 417
Bitter almond spirit, 387
almond syrup, 325
water, 306
orange elixir, 402
peel fluidextract, 538
stomachic drops, 496
substances, 248
tincture, 496
of zedoary, 512
wine of iron, 516
Bitterless syrup of quinidine, 346
Bittersweet fluidextract, 576
Bituminous coal, 116
Black cohosh fluidextract, 541
haw, elixir, 424
fluidextract, 564
lotion, 372
snake-root, fluidextract, 541
wash, 372
Blackberry cordial, 425
elixir, compound, 420
fruit syrup, 347
Black's blowpipe, 136
Bladder joints, 164
Blast lamp, Russian, 120
Blistering collodion, 428
liquid, 315
Block weights, 71
Bloodroot syrup, 348
tincture, 491
Blowpipes, 136
uses, 136
Blue flag fluidextract, 580
flame coal oil stove, 121
Board of Trustees, U. S. P., 28
Bogardus mill, 197
Boiler, Patch's tubular, 143
Boiling, 147
point, 148
determination, 148
table, 149
for saturated solutions, 140
points, thermometer, 129
Boldo fluidextract, 568
Bolting cloth sieves, 207
Borax and honey, 352
of rose, 351
glycerite, 374
Borers for corks, 163, 164
Boroglycerin glycerite, 375
Botanical name, 33
Botany, 25
Bottle, specific gravity, 81
wash, 220
Bottles, receiving, for percolators, 297
Bougies, 647
and catheters, 301
Box prescription scales, 67, 68
Brandy, 385
Brayera, infusion, 454
Breast tea, 459
British Pharmacopœia, 26
Bromide, ammonium, elixir, 400
calcium, elixir, 403
lithium, elixir, 416
potassium and chloral, compound mixture, 365
elixir, 419
sodium elixir, 420
Bromides, elixir, three, 423
syrup, 336
Brown infusion, 456
mixture, 363
Brownian movement, 221
Brussels conference, 27
Bryonia tincture, 497
Buchu and potassium acetate elixir, 403
elixir, 403
compound, 403
fluidextract, 539
compound, 568
infusion, 456
tincture, 468
Buckthorn bark fluidextract, 546
berries syrup, 347
Buhrstone, 193
mill, 193
Bulb blowpipe, 136
Bumping, 168
Bunsen burners, 123
Bunsen's clamp, 168
pump, 240
Burner, Fletcher's radial, 124
Burners, Bunsen, 123
Springfield, 124
Bushel, 43
Bitter orange peel tincture, 471

C.

Cactus grandiflorus, tincture, 498
Cade petrox, 442
petroxolin, 442
Cage, wire for still, 178
Cajuput spirit, 385
Cake sublimates, 181
Calabar bean tincture, 488
Calcination, 138
Calcium and sodium glycerophosphates, elixir, 404
and sodium hypophosphites, syrup, 336
bromide elixir, 403
hydrochlorophosphate, syrup, 337
hydroxide, syrup, 325
hypophosphite, elixir, 404
syrup, 337
iodide syrup, 337
lactophosphate and iron syrup, 338
lactophosphate elixir, 404
syrup, 328
phosphate with cod liver oil, emulsion, 358
Calendula fluidextract, 568
tincture, 498
Calisaya bark fluidextract, 542
elixir, 406
and hypophosphites, 407
ferrated, 406
with iron and bismuth, 407
with iron and calcium lactophosphate, 408
Calumba infusion, 456
tincture, 473
Camphor and chloroform petrox, 442
liniment, 432
ammoniated, 431
mixture, acid, 364
aromatic, 364
Parrish's, 364
spirit, 388
wash, ammoniated, 372
water, 307
Camphorated chloroform petroxolin, 442
oil, 432
phenol petrox, 444
petroxolin, 444
soap liniment, 435
tincture of opium, 487
Canada liniment, 434
snake-root, syrup, compound, 336
Cannabis extract, 621
fluidextract, 540
tincture, 473
Indica extract, 621
Cantharidal collodion, 428
Cantharides tincture, 474
Cantharidis tinctura, P. I., 474
Cantharidin vinegar, 603

Canton flannel strainers, 227
Capacity, metric measures, 47
unit, metric, 45
Capsicum and myrrh tincture, 499
oleoresin, 599
tincture, 474
Caramel tincture, 499
Carbolic acid glycerite, 376
water, 311
Carbolized oil, 447
Carbon disulphide, 214
as solvent, 214
Cardamom elixir, compound, 405
spirit, compound, 392
tincture, 475
compound, 475
Carminative, Dalby's, 364
Dewees', 367
mixture, 364
Carron oil, 432
Cartier's hydrometer, 87
Cascara sagrada, elixir, 405
elixir, compound, 405
extract, 622
fluidextract, 540
aromatic, 541
fluidglycerate, 591
aromatic, 592
syrup, aromatic, 325
Cascarilla infusion, 456
tincture, 468
Castor oil, aromatic, 447
emulsion, 359
Cataplasm, emollient, 459
Cataplasms, 311, 647
Catechu, pale, tincture, compound, 479
Cathartic elixir, compound, 406
Catheters, 647
Catnep fluidextract, 569
Caulophyllum fluidextract, 570
Cc., 47
Celery fruit fluidextract, 566
Celsius, 126
Centesimal alcoholmeter, 87
Centigrade, 126
thermometer, 127
Centi, 45
Centigramme, 47
Centimeter, 46
Centrifugal filter, 243
filtration, 242
Centrifuge, 278
Cerates, 301, 647
Cetraria decoction, 458
Chalk mixture, 363
Chapman's mixture, 366
pump, 241
Charcoal, 116
animal for decolorizing, 247
Chaser mills, 194
Chasers, 194
Chemical food, 345
formulas, 33
precipitates, 252
solution, 211, 312
Chemistry, 25
Chestnut leaves, fluidextract, 569
Chilean Pharmacopœia, 26
Chimaphila, fluidextract, 570
Chimney of furnace, 117
Chionanthus fluidextract, 570
Chirata fluidextract, 570
Chiretta infusion, 456
tincture, 468
Chloral and bromide compound, 365
and potassium bromide, compound mixture, 365
syrup, 325
Chloride, ammonium, mixture, 364
ferrous, syrup, 341
Chlorinated lime solution, 315
Chloroform, 213
and aconite liniment, 434
and morphine, compound mixture, 365
tincture, 468
and opium mixture, compound, 368
anodyne, 365
as solvent, 213
emulsion, 355
liniment, 433
petroxolin, camphorated, 442
spirit, 388
water, 307
Cholera mixture, Sun, 368
Chondrus mucilage, 353
Chromic acid solution, 315
Churchill's tincture iodine, 503
Cimicifuga extract, 622
fluidextract, 541
syrup, compound, 338
tincture, 499
Cinchona, 36
alkaloids, elixir, 406
elixir, 406
and hypophosphites, 407
ferrated, 406
with iron and bismuth, 407
with iron and calcium lactophosphate, 408
with iron and strychnine, 408
with iron, bismuth and strychnine, 407
extract, 636
fluidextract, 542
aqueous, 571
infusion, 454
tincture, 476
compound, 476
Cinnamon spirit, 389
syrup, 339
tincture, 477
water, 308
Circulatory maceration, 269
solution, 213
Citrate, lithium, elixir, 416
of iron, wine, 516
Citric acid, syrup, 326
Clamp, Bunsen's, 168
Clarification, 245
Clarified honey, 351
Clarifying by subsidence, 247
questions, 248
with albumin, 245
with fermentation, 247
with gelatin, 246
with milk, 246
with paper pulp, 246
Clay crucibles, 137
Cleavage, 257
Clinical thermometer, 128
Clinometric crystals, 255
Closet, drying, 119, 185
for percolation, 297
Cloves, infusion, 456
Coal, 116, 117
oil, 121
flashing point, 121
stove, 121
Coarse powder, 207
Cocaine oleate, 438
Cocculus indicus, tincture, 499
Cochineal tincture, 468
Cocillana fluidextract, 572
Cod liver oil emulsion, 356
with calcium lactophosphate, 357
with calcium phosphate, 358
with egg, 359
with hypophosphites, 358
with malt, 358
with wild cherry, 359
Codeine and terpin hydrate elixir, 422
syrup, 339
Coffee fluidextract, 572
Cohosh, black, fluidextract, 541
Coil for steam, 145
Coke, 117
Colation, 226
Colchici tinctura, P. I., 477
Colchicum corm extract, 623
fluidextract, 572
wine, 515
seed, fluidextract, 543
tincture, 477
wine, 516
Collodia, 427
Collodion, 427
blistering, 428
cantharidal, 428
croton oil, 429
flexible, 428
iodine, 429
iodoform, 429
salicylic, compound, 429
styptic, 429
vesicating, 428
Collodions, 301, 427
Collodium, 427
cantharidatum, 427, 428
flexile, 427, 428

Collodium, salicylici compositum, 427, **429**
iodi, 427, **429**
iodoformi, 427, **429**
stypticum, 427, **429**
tiglii, 427, **429**
Colloidal bismuth, 268
copper, 268
gold, 268
iron, 268
silver, 221, 268
solutions, 221
Colloids, 266, 268
Colocynth extract, **624**
compound, **624**
Cologne water, **392**
Colophony, 642
Colton's percolator, 294
Columbian spirit, 119
Combustion chamber, 117
Comminution, 189, 285
questions, 210
Committee of Revision of U. S. P., 28
Compound cathartic elixir, **406**
croton oil liniment, **436**
decoction of aloes, **458**
of sarsaparilla, **457**
elixir of almond, **401**
blackberry, **420**
buchu, **403**
cardamom, **405**
cascara sagrada, **405**
corydalis, **409**
formates, **411**
glycerophosphates, **413**
orange, **514**
pepsin and rennin, **418**
sodium salicylate, **421**
taraxacum, **422**
vanillin, **423**
viburnum opulus, **424**
extract of colocynth, **624**
fluidextract of buchu, **568**
sarsaparilla, **557**
stillingia, **588**
gargle of guaiac, **371**
infusion of gentian, **455**
orange peel, **456**
rose, **455**
senna, **454**
iron mixture, **366**
lever balances, 67
liniment of mustard, **435**
opium, **434**
soft soap, **435**
menthol spray, **446**
mixture of chloral and potassium bromide, **365**
chloroform and morphine, **365**
glycyrrhiza, **363**
opium and chloroform, **368**
rhubarb, **370**
senna, **362**
oil of hyoscyamus, **602**
salicylic collodion, **429**
Compound solution of glycerophosphates, **413**
spirit of cardamom, **392**
ether, **391**
horseradish, **385**
juniper, **390**
lavender, **484**
myrcia, **392**
orange, **388**
spirit of vanillin, **393**
sulphurated petrox, **445**
petroxolin, **445**
syrup of actæa, **338**
asarum, **336**
Canada snake-root, **336**
cimicifuga, **338**
figs, **342**
hydrochlorophosphates, **345**
hypophosphites, **343**
phosphates, **345**
sarsaparilla, **332**
senna, **349**
squill, **333**
stillingia, **350**
white pine, **346**
white pine with morphine, **346**
tincture of benzoin, **472**
cardamom, **475**
chloroform and morphine, **468**
cinchona, **476**
cudbear, **508**
gambir, **479**
gentian, **480**
jalap, **505**
kino, **505**
kino and opium, **505**
lavender, **484**
pale catechu, **479**
guaiac, **502**
senega, **468**
viburnum, **511**
zedoary, **512**
wine of orange, **514**
rhubarb, **519**
Condensation, 160
Condenser, Liebig's, 169
tube, 170
Condensing worm, 171
Condurango fluidextract, **573**
Confections, 301, 647
Conference for Unification of Potent Remedies, 27
Congealing point, 133
Conical graduates, 74
percolator, 282, 284
Conium extract, **637**
fluidextract, **573**
Continuous filtration, 237
percolation, 525
washing, 223
Contusion, 191
Convallaria root, fluidextract, **574**
Convallariæ flowers, fluidextract, **574**
Convention of U. S. P., 28
Converting thermometer readings, 127
Cotton root bark, fluidextract, **578**
Copaiba and opium mixture, **366**
mixture, **366**
Copper percolator, 294
water bath, 141
Coptis fluidextract, **574**
Cordial, blackberry, **425**
Curaçao, **402**
Godfrey's, **369**
neutralizing, **369**
Cordiale rubi fructus, **425**
Cordialia, 424
Cordials, 301, 424
Cork borers, 162
fitting, 163
Corm, colchicum, extract, **623**
fluidextract, **572**
wine, **515**
Cornus fluidextract, **575**
Corydalis, elixir, compound, **409**
fluidextract, **575**
Coto fluidextract, **583**
tincture, **506**
Cotton cloth, 227
strainer, 227
flannel strainers, 227
root bark decoction, **458**
Couch grass, decoction, **458**
fluidextract, **562**
Counter scales, 65, 67
Cover for percolator, 288
Coxe's hive syrup, **333**
Creosote petrox, **442**
petroxolin, **442**
water, **308**
Croton liniment, **436**
oil collodion, **429**
liniment, **436**
compound, **436**
Crucible, black lead, **137**
furnace, **137**
Hessian, 137
operations, 137
tongs, 138
Crude malate of iron, 638
Crystallization, 255
intermediate, 262
questions, 263
water of, 260
Crystallizing vessels, 261
Crystallography, 255, 256
Crystalloids, 266
Crystals, 255
by electric currents, 260
by fusion and partial cooling, 258
by sublimation, 258
collecting, draining, washing and drying, 261
during evaporation, 260
from nuclei, 259
growing, 259
nursing, 259
methods of obtaining, 258
retarding, 259
supersaturated solutions, 258
Cubeb fluidextract, **575**
oleoresin, **600**

Cubeb tincture, **500**
Cubic centimeter, **47**
inch, 43
Cucurbit, 160
Cudbear tincture, **507**
compound, **508**
Cup weights, 71
Curaçao cordial, **402**
elixir, **402**
Curtman's still, 172
Cusso fluidextract, **534**
Cutter for tobacco, 189
rotary, 190
Cutting, 189
glass tubes, 162
Cylindrical graduates, 74
percolator, 282
Cypripedium fluidextract, **575**

D.

Dalby's carminative, **364**
Damiana fluidextract, **576**
Dandelion fluidextract, **562**
Danish Pharmacopœia, 26
Datura seeds, tincture, **468**
Decantation, 223
Deci, 45
Decimal system, 45
Decocta, 456, 457
Decoction, 269
mug, 456
acacia bark, **458**
aloes, compound, **458**
cetraria, **458**
cotton root bark, **458**
couch grass, **458**
Iceland moss, **458**
ispaghula, **458**
logwood, **458**
sappan, **458**
sarsaparilla, compound, **457, 458**
milder, **458**
stronger, **458**
triticum, **458**
Zittmann's, milder, **458**
stronger, **458**
Decoctions, 301, 456, 457
general formula, 457
Decoctum acaciæ, corticis, **458**
agropyri, **458**
aloes compositum, **458**
cetrariæ, **458**
gossypii radicis corticis, **458**
hæmatoxyli, **458**
ispaghulæ, **458**
sappan, **458**
sarsaparillæ compositum, **457, 458**
fortius, **458**
mitius, **458**
Decoloration, 247
questions, 248
Decolorized tincture of iodine, **504**
Decolorizing with animal charcoal, 247
Decrepitation, 261
Definition, official, 34
Deflagration, 138
Deka, 45
De Laval centrifugal filter, 242
Deliquescence, 261
Densimeter, Rousseau's, 90
Densimetre hydrostatique, 89
Density of solutions, 212
Deodorized opium, tincture, **488**
Description, official, 35
Desiccating frame and trays, 185
Desiccation, 147, 184
questions, 210
Desiccator, 187
Dessertspoonful equivalent, 45
Destructive distillation, 180
Determination of boiling points, 148
of crystalline form, 257
of solubility, 214
Dewees' carminative, **367**
tincture of guaiac, **502**
Diacetylmorphine and terpin hydrate elixir, **423**
Diagram, metric, 46
Dialysis, 266
questions, 268
Dialyzed iron, 268
Dialyzer, 266
Diarrhœa mixture, Squibb's, **368**
Dica's hydrometer, 87
Diclinic system, 257
Diffusate, 267
Digestion, 269, 270
Digitalis fluidextract, **544**
infusion, **453**
tincture, **478**
tinctura, P. I., **478**
Diluted acids, 301
iodine petroxolin, **443**
Dimetric octahedron, 256
or quadratic system, 256
Dimorphous crystals, 255
Dioscorea fluidextract, **576**
Dish, evaporating, graduated, 157
Dishes for evaporating liquids, 152
Disintegrator, Abbé, 190
Mead's, 197
Disk filter, 242
Dispensatories, 26, 38
Dispensing counter funnel, 235
mill, 199
Dispersed phase, 221
Dispersion medium, 221
Dispersoid, 221
Displacement, 280
washing, 222
Distillation, 147, 160, 304
by flask, 162
destructive, 180
fractional, 179
questions, 183
Distilled extract of witch hazel, **309**
water, **308**
Distilled water, sterilized, **309**
Distilling bulb, **148**
flask, 161
point table, 149
Dorvault's L'Officine, **27**
Doses, 36
Double beam, unequal arm balances, 66
hexagonal pyramid, 257
jar mill, 195
plain filter, 230
screw presses, 274
stirrer, 153
tube percolator, 292
Dover's powder, syrup, **344**
tincture, **504**
Drachm weights, 72
Drop, 76
equivalent, 45
table, 77
Drops, Bateman's, **507**
Hoffmann's, **385**
hot, **499**
Lamotte's, **501**
pectoral, **507**
stomach, **496**
stomachic, bitter, **496**
Drosera fluidextract, **576**
Drug mills, 193
"Druggists dry granular sugar," 317
Drugs and Food Act, 27
drying, loss in weight, 187, 188
Drum sieves, 205
Drying closet, 119, 185
crystals, 261
drugs, loss in weight, 187, 188
oven, 186
Dryers, vacuum, 154
Dudgeon's press, 277
Duplex graduates, 75
Dursse's percolator, 290
Dutch Pharmacopœia, 26

E.

Easton's syrup, **341**
Eau sedative de raspail, **372**
Ebullition, 147, 168
Echinacea fluidextract, **577**
Economy gas stove, 124
Effervescent salts, 264, 301, 647
Efflorescence, 261
Egg yolk glycerite, **379**
with cod liver oil emulsion, 359
Elæometer, 86
Electrical stoves, 126
Electricity as a source of heat, 125
Elixir adjuvans, **400**
ammonii bromidi, 394, **400**
valeratis, 394, **401**
valerianatis, **401**
ammonium bromide, **400**
valerate, **401**
amygdalæ compositum, 394, **401**

Elixir, anise, 402
anisi, 394, 402
aromatic, 400
red, 402
aromaticum, 393, 400
rubrum, 394, 402
aurantii amari, 394, 402
aurantiorum compositum, 514
bismuth, 402
bismuthi, 395, 402
bitter orange, 402
black haw, 421
blackberry, compound, 420
buchu, 398, 403
and potassium acetate, 403
compositum, 398, 403
et potassii acetatis, 395, 403
calcii bromidi, 395, 403
et sodii glycerophosphatum, 395, 404
hypophosphitis, 395, 404
lactophosphatis, 395, 404
calcium and sodium glycerophosphates, 404
bromide, 403
hypophosphite, 404
lactophosphate, 404
calisaya, alkaloidal, 406
with hypophosphites, 407
with iron and bismuth, 407
with iron and pepsin, 408
with iron and strychnine, 408
with iron, bismuth and strychnine, 407
iron and lactophosphate of lime, 408
cardamom, compound, 405
cardamomi compositum, 394, 405
cascara sagrada, 405
compound, 405
cascaræ sagradæ, 398, 405
compositum, 398, 405
cathartic, compound, 406
catharticum compositum, 398, 406
cinchona alkaloids, 406
and hypophosphites, 407
and iron, 406
iron and bismuth, 407
and calcium lactophosphate, 408
and pepsin, 408
and strychnine, 408
Elixir, cinchona alkaloids, iron, bismuth and strychnine, 407
cinchonæ, 406
alkaloidorum, 395, 406
et ferri, 395, 406
et hypophosphitum, 395, 407
ferri, bismuthi et strychninæ, 395, 408
et bismuthi, 395, 407
et calcii lactophosphatis, 395, 408
et pepsini, 395, 408
et strychninæ, 395, 407
ferri, bismuthi et strychninæ, 407
et bismuthi, 407
et calcii lactophosphatis, 408
et pepsini, 408
et strychninæ, 408
corrigens, 409
corydalis compositum, 398, 409
Curacao, 402
Curassao, 402
eriodictyi aromaticum, 394, 409
eriodictyon, aromatic, 409
ferri hypophosphitis, 396, 409
lactatis, 396, 410
phosphatis, 396, 410
pyrophosphatis, 396, 410
quininæ et strychninæ, 396, 410
quininæ et strychninæ, 396, 411
phosphatum, 400
ferric hypophosphite, 409
phosphate, 410
pyrophosphate, 410
quinine and strychnine, 410
formates, 411
compound, 411
formatum, 396, 411
compositum, 396, 411
gentian, 412
and ferric phosphate, 413
and iron, 412
glycerinated, 413
with tincture of ferric citro-chloride, 412
gentianæ, 399, 412
cum tinctura ferri chloridi, 412
et ferri, 396, 412
phosphatis, 396, 413
ferratum, 413
glycerinatum, 399, 413
glycerophosphates, 404
compound, 413
glycerophosphatum, 404
compositum, 396, 413
Elixir glycyrrhiza, 400
aqueous, 414
aromatic, 414
glycyrrhizæ, 393, 400
aquosum, 394, 414
aromaticum, 394, 414
guarana, 414
guaranæ, 399, 414
hops, 415
humuli, 399, 415
hypophosphites, 415
and iron, 415
hypophosphitum, 397, 415
et ferri, 397, 415
iron lactate, 410
quinine and strychnine, 411
laxative, 405
licorice, 400
aqueous, 414
aromatic, 414
lithii bromidi, 397, 416
citratis, 397, 416
salicylatis, 397, 416
lithium bromide, 416
citrate, 416
salicylate, 416
of almond, compound, 401
orange, compound, 514
pepsin, 416
and bismuth, 417
and iron, 417
and rennin, compound, 418
bismuth and strychnine, 417
pepsini, 399, 416
bismuthi et strychninæ, 399, 417
et bismuthi, 399, 417
et ferri, 399, 417
et rennini compositum, 399, 418
phosphates of iron, quinine, and strychnine, 400
phosphori, 397, 418
et nucis vomicæ, 397, 419
phosphorus, 418
and nux vomica, 419
potassii acetatis, 397, 419
et juniperi, 397, 419
bromidi, 397, 419
potassium acetate, 419
and juniper, 419
bromide, 419
pyrophosphate of iron, 410
quininæ valeratis et strychninæ, 397, 426
quinine valerate and strychnine, 420
quininæ valerianatis et strychninæ, 420
red, 402
rhamni purshianæ, 405
compositum, 405

Elixir rubi, compositum, 399, 420
simple, 400
sodii bromidi, 397, 420
hypophosphitis, 397, 421
salicylatis, 397, 421
compositum, 398, 421
sodium bromide, 420
hypophosphite, 421
salicylate, 421
compound, 421
strychninæ valeratis, 398, 421
valerianatis, 421
strychnine, valerate, 421
taraxaci compositum, 394, 422
taraxacum, compound, 422
terpin hydrate, 422
and codeine, 422
and diacetylmorphine, 423
and heroine, 423
terpini hydratis, 398, 422
hydratis cum heroina, 423
et codeinæ, 398, 422
et diacetylmorphinæ, 398, 423
three bromides, 423
trium bromidorum, 398, 423
vanillin, compound, 423
vanillini compositum, 394, 423
virburni opuli compositum, 399, 424
prunifolii, 399, 424
viburnum opulus, compound, 424
prunifolium, 424
yerba santa, aromatic, 409
zinc valerate, 424
zinci valeratis, 98, 424
valerianatis, 424
Elixiria, 393
Elixirs, 301, 393
Elm mucilage, 353
Elutriating apparatus, 208
Elutriation, 208
Emollient cataplasm, 459
species, 459
Emulsa, 354
Emulsion flavors, 357
almond, 355
ammoniac, 355
asafetida, 356
castor oil, 359
chloroform, 355
cod liver oil, 356
with calcium lactophosphate, 357
with calcium phosphate, 358
with egg, 359
with hypophosphites, 358
with malt, 358
with phosphate of lime, 358
Emulsion, cod liver oil, with wild cherry, 359
oil of turpentine, 356
petrolatum, 360
Emulsions, 301, 354
questions, 380
Emulsum ammoniaci, 355
amygdalæ, 354, 355
asafœtidæ, 354, 356
chloroformi, 355
olei morrhuæ, 354, 356
cum calcii lactophosphate, 355, 357
phosphate, 355, 358
hypophosphitibus, 355, 358
malto, 355, 358
pruno virginiana, 355, 359
vitello, 355, 359
ricini, 355, 359
terebinthinæ, 354, 356
petrolati, 355, 360
petrolei, 360
Enamelled steam kettle, 144
Enclosed sifter, 206
English silver penny, 41
titles, official, 31
weights, origin, 41
Enterprise mill, 199
press, 273
Equivalent of teaspoonful, tablespoonful, etc., 45
Equivalents, metric, 48, 49, 50
weights and measures, 50
drops, 77
Ergot extract, 624
aqueous, 627
fluidextract, 544
infusion, 456
tincture, ammoniated, 500
Ergotin, P. I., 637
Eriodictyon elixir, aromatic, 409
fluidextract, 545
syrup, aromatic, 339
Essence of peppermint, 390
pepsin, 418
Essentia pepsini, 418
Ether, 213
as solvent, 213
nitrous, spirit, 385
spirit, 385
compound, 391
Ethereal solutions, 301, 427
questions, 448
tincture of ferric chloride, 501
lobelia, 468
tinctures, 495
Ethyl alcohol, 119
Eucalyptol petrox, 442
petroxolin, 442
spray, 446
Eucalyptus fluidextract, 545
Euonymus extract, 638
fluidextract, 577
Eupatorium fluidextract, 577
Euphorbia pilulifera, fluidextract, 577
Evaporating chamber, 155
dish, graduated, 157
vessels, 152
Evaporation, 147
below the boiling point, 152
by direct heat, 156
from surface, 155
of liquids by boiling, 151
spontaneous, 156
to a fixed volume, 157
Executive Committee, U. S. P., 28
Exercises, mathematical, 95
answers, 108
Expectorant, Stokes', 369
Expression, 271
questions, 279
Exsiccation, 147, 261, 264, 265
questions, 268
Extract of aconite, 618
aloes, 635
apples, ferrated, 638
tincture, 502
arnica root, 618
belladonna, green, 606
leaves, 619
cannabis, 621
cascara sagrada, 522
cimicifuga, 622
cinchona, 636
colchicum corm, 623
colocynth, 624
compound, 624
conium, 637
ergot, 624
aqueous, 637
euonymus, 638
gelsemium, 625
glycyrrhiza, 626
pure, 627
golden seal, 627
gentian, 626
hematoxylon, 639
hydrastis, 627
hyoscyamus, 628
green, 606
ignatia, 639
jalap, 640
krameria, 640
leptandria, 640
licorice, 626
malt, 629
nux vomica, 629
opium, 630
oxgall, 625
physostigma, 631
podophyllum, 641
quassia, 641
rhamnus purshiana, 622
rhubarb, 632
stramonium, 632
sumbul, 634
table, 612
taraxacum, 634
viburnum prunifolium, 635
witch hazel, distilled, 309
Extracta, 606

Extraction, 269
apparatus, hot, 296
questions, 270
Extractive, 607
Extracts, 301, 606
from fresh plants, 606
pilular, 608, 609, 617
powdered, 608, 609, 617
preparation, 609
preservation, 609
questions, 648
Extractum aconiti, 613, 618
aloes, 616, 635
arnicæ radicis, 618
fluidum, 534
belæ liquidum, 534
belladonnæ foliorum, 619
(pilular), 612
(powdered), 613
viride, 618
cannabis, 612, 621
indicæ, 621
cascaræ sagradæ, 615, 622
cimicifugæ, 613, 622
cinchonæ, 616, 636
colchici, 618
cormi, 613, 623
colocynthidis, 614, 624
compositum, 615, 624
conii, 616, 637
cusso fluidum, 534
ergotæ, 612, 624
aquosum, 616, 637
euonymi, 616, 638
fellis bovis, 613, 625
ferri pomatura, 616, 638
gelsemii, 613, 625
gentianæ, 612, 626
glycyrrhizæ, 612, 626
purum, 612, 627
hæmatoxyli, 616, 639
hydrastis, 614, 627
hyoscyami, 612, 628
ignatiæ, 616, 639
jalapæ, 616, 640
krameriæ, 617, 640
leptandræ, 616, 640
malti, 612, 629
menispermi fluidum, 534
nucis vomicæ, 614, 629
opii, 615, 630
liquidum, 534
physostigmatis, 614, 631
picrorhizæ liquidum, 534
podophylli, 616, 641
quassiæ, 617, 641
rhamni purshianæ, 622
rhei, 614, 632
stramonii, 632
(pilular), 612
(powdered), 614
strophanthi, 618
sumbul, 612, 634
taraxaci, 612, 634
viburni prunifolii, 615, 635

F.

Fahrenheit, 126
thermometer, 127
Fahrenheit's hydrometer, 87
Fairbank's druggists' scale, 66
Felt strainers, 226
Fennel water, 309
Fermentation for clarifying, 247
Ferrated elixir of calisaya, 406
calisaya alkaloidal, 406
gentian, 413
extract of apples, 638
tincture, 502
wine of wild cherry, 519
Ferri iodidi syrupus P. I., 328
malas crudus, 638
Ferric chloride solution, 315
tincture, 479
ethereal, 501
citro-chloride, tincture, 501
hydroxide magma, 370
hypophosphite elixir, 409
syrup, 340
phosphate and gentian elixir, 413
elixir, 410
pyrophosphate, elixir, 410
quinine and strychnine, elixir, 410
Ferrous chloride, syrup, 341
iodide, syrup, 328
phosphate syrup, 325
Ferrum dialysatum, 268
Fetid spirit of ammonia, 385
Figs, syrup, compound, 342
Files, 164
Filter, 231, 253
centrifugal, 242
disk, 242
De Laval centrifugal, 242
Hadden's, 236
pressure, 242
Warner's, 236
Filtering, centrifugal, 242
under pressure, 242
Filters, folding, 230
for special purposes, 235
paper, 229
plain, 230
plaited, 231
Rother's, 230
Filtrate, 229
Filtration, 229
centrifugal, 242
continuous, 237
hot, 238, 239
of volatile liquids, 237
questions, 244
rapid, 239
through an absorbent powder, 303
pulped or shredded filter paper, 303
under pressure, 242
Fine powder, 207
Fineness of powders, 206
Finnish Pharmacopœia, 26
Fisher's vacuum pump, 240
Flag, blue, fluidextract, 580
Flashing point for coal oil, 121
Flask distillation, 162
evaporation, 156
Flavored syrup, 317
Flavors for emulsions, 357
Fletcher's gas crucible furnace, 137
radial burner, 124
Flexible collodion, 428
Flocculation, 221
Flocculent, 252
Florentine receiver, 250
Flowers, convallariæ, fluidextract, 574
Fluidacetracts, 527
Fluidextract of aconite, 535
adonis, 565
aletris, 565
angelica root, 566
apocynum, 566
aralia, 567
arnica, 567
root, 534
aromatic, 536
asclepias, 567
aspidosperma, 537
baptisia, 567
belladonna root, 539
berberis, 568
bitter orange peel, 538
bittersweet, 576
black cohosh, 541
haw, 564
snake-root, 541
blue flag, 580
boldo, 568
buchu, 539
compound, 568
buckthorn bark, 546
calendula, 568
calisaya bark, 542
calumba, 569
cannabis, 540
caulophyllum, 570
cascara sagrada, 540
aromatic, 541
catnep, 569
celery, 566
chestnut leaves, 569
chimaphila, 570
chionanthus, 570
chirata, 570
cimicifuga, 541
cinchona, 542
aqueous, 571
cocillana, 572
coffee, 572
colchicum corm, 572
seed, 543
condurango, 573
conium, 573
convallaria flowers, 574
root, 574
coptis, 574
cornus, 575
corydalis, 575
coto, 583
cotton root bark, 578
couch grass, 562
cubeb, 575
cusso, 534
cypripedium, 575
damiana, 576
dandelion, 562
digitalis, 544
dioscorea, 576
drosera, 576

Fluidextract echinacea, 577
ergot, 544
eriodictyon, 545
eucalyptus, 545
euonymus, 577
eupatorium, 577
euphorbia piluliferæ, 577
frangula, 546
fucus, 578
galega, 578
gelsemium, 546
gentian, 547
geranium, 578
ginger, 565
glycyrrhiza, 547
golden seal, 550
green hellebore, 563
grindelia, 549
guarana, 549
hamamelis leaves, 579
helianthemum, 579
helonias, 579
henbane, 551
hops, 579
hydrangea, 580
hydrastis, 550
hyoscyamus, 551
ipecac, 551
jaborandi, 554
jalap, 580
juglans, 580
juniper berries, 581
kava, 581
kola, 581
krameria, 581
lappa, 582
leptandra, 582
licorice, 547
lobelia, 552
lupulin, 582
matico, 582
menisperma, 534
mezereum, 583
mullein leaves, 590
rumex, 586
musk root, 561
nux vomica, 553
paracoto, 583
pareira, 583
parsley root, 583
phytolacca, 584
pilocarpus, 554
pink root, 560
podophyllum, 554
pomegranate, 548
prickly ash, 564
quassia, 584
quebracho, 537
quercus, 585
saw palmetto, 556
rhamnus cathartica, 585
purshiana, 540
aromatic, 541
rhubarb, 555
rhus glabra, 585
rose, 555
rubus, 586
sabal, 556
sanguinaria, 586
sarsaparilla, 557
compound, 557
scoparius, 586
scutellaria, 587
Fluidextract senecio, 587
senega, 559
senna, 559
serpentaria, 587
solanum, 587
spigelia, 560
squill, 558
staphisagriæ, 560
stavesacre, 560
stillingia, 561
compound, 588
stramonium, 588
sumbul, 561
table, 529
taraxacum, 562
thuja, 589
thyme, 589
trifolium, 589
trillium, 589
triticum, 562
type processes, 521, 523, 524, 527
uva ursi, 563
valerian, 590
veratrum viride, 563
verbena, 590
viburnum opulus, 590
prunifolium, 564
wild cherry, 584
xanthoxylum, 564
yerba santa, 545
zea, 591
Fluidextracta, 519
Fluidextracts, 301, 519
acetic, 527
alcoholic percentage, 528
for infusions, 453
from green drugs, 528
preservation, 527
Fluidextractum aconiti, 530, 535
adonidis, 532, 565
aletridis, 532, 565
angelicæ radicis, 532, 566
apii fructus, 532, 566
apocyni, 533, 566
araliæ, 532, 567
arnicæ, 532, 567
radicis, 534
aromaticum, 530, 536
asclepiadis, 532, 567
aspidospermatis, 530, 537
aurantii aurari, 530, 538
baptisiæ, 532, 567
belladonnæ radicis, 529, 539
berberidis, 532, 568
boldi, 532, 568
buchu, 529, 539
compositum, 532, 568
calendulæ, 532, 568
calumbæ, 533, 569
cannabis, 529, 540
Indicæ, 540
cascaræ sagradæ, 531, 540
aromaticum, 531, 541
castaneæ, 534, 569
catariæ, 533, 569
caulophylli, 532, 570
chimaphilæ, 532, 570
chionanthi, 532, 570
chiratæ, 532, 570
cimicifugæ, 529, 541
Fluidextractum cinchonæ, 530, 542
aquosum, 534, 571
cocillanæ, 532, 572
coffeæ, 533, 572
tostæ, 572
colchici cormi, 532, 572
seminis, 529, 543
condurango, 532, 573
conii, 534, 573
convallariæ, 574
florum, 532, 574
radicis, 532, 574
coptis, 533, 574
corni, 533, 575
corydalis, 532, 575
coto, 583
cubebæ, 532, 575
cusso, 534
cypripedii, 533, 575
damianæ, 532, 576
digitalis, 529, 544
diosceræ, 532, 576
dioscoreæ, 532, 576
dulcamaræ, 533, 576
echinoceæ, 532, 577
ergotæ, 530, 544
eriodictyi, 529, 545
eucalypti, 529, 545
euonymi, 532, 577
eupatorii, 533, 577
euphorbiæ piluliferæ, 533, 577
frangulæ, 531, 546
fuci, 532, 578
galegæ, 533, 578
gelsemii, 529, 546
gentianæ, 529, 547
geranii, 533, 578
glycyrrhizæ, 531, 547
gossypii corticis, 532, 578
granati, 530, 548
grindeliæ, 529, 549
guaranæ, 529, 549
hamamelidis foliorum, 533, 579
helianthimi, 533, 579
helioniatis, 533, 579
humuli, 532, 579
hydrangeæ, 532, 580
hydrastis, 530, 550
hyoscyami, 529, 551
ipecacuanhæ, 530, 551
iridis versicoloris, 532, 580
jalapæ, 532, 580
juglandis, 533, 580
juniperi, 533, 581
kavæ, 532, 581
kolæ, 532, 581
krameriæ, 533. 581
lappæ, 533, 582
leptandræ, 533, 582
lobeliæ, 530, 552
lupulini, 532, 582
matico, 532, 582
menispermi, 534
mezerei, 532, 583
nucis vomicæ, 529, 553
opii, 534
paracota, 532, 583
pareiræ, 533, 583
petroselini radicis, 532, 583

Fluidextractum phytolaccæ, 533, **584**
picrorhizæ, **534**
pilocarpi, 529, **554**
podophylli, 529, **554**
pruni virginianæ, 534, **584**
quassiæ, 533, **584**
quercus, 533, **585**
rhamni catharticæ, 533, **585**
purshianæ, **540**
aromaticum, **541**
rheii, 529, **555**
rhois glabræ, 533, **585**
rosæ, 530, **555**
rubi, 533, **586**
rumicis, 533, **586**
sabal, 529, **556**
sanguinariæ, 533, **586**
sarsaparillæ, 529, **557**
compositum, 530, **557**
scillæ, 529, **558**
scoparii, 533, **586**
scutellariæ, 533, **587**
senecionis, 532, **587**
senegæ, 529, **559**
sennæ, 529, **559**
serpentariæ, 532, **587**
solani, 532, **587**
spigeliæ, 529, **560**
staphisagriæ, 529, **560**
stercullæ, **581**
stillingiæ, 529, **561**
compositum, 533, **588**
stramonii, 532, **588**
sumbul, 529, **561**
taraxaci, 530, **562**
thujar, 532, **589**
thymi, 533, **589**
trifolii, 533, **589**
trillii, 532, **589**
tritici, 531, **562**
uvæ ursi, 530, **563**
valerianæ, 532, **590**
veratri viridis, 529, **563**
verbasci foliæ, 533, **590**
verbenæ, 533, **590**
viburni opuli, 532, **590**
prunifolii, 529, 564
xanthoxyli, 529, **564**
zeæ, 533, **591**
zingiberis, 529, **565**
Fluidglycerata, 591
Fluidglycerate of cascara sagrada, **591**
aromatic, **592**
glycyrrhiza, **593**
krameria, **593**
licorice, **593**
rhubarb, **594**
Fluidglycerates, 301, **591**
general process, 591
Fluidglyceratum cascaræ sagradæ, **591**
aromaticum, **592**
glycyrrhizæ, **593**
krameriæ, **593**
rhei, **594**
Folding filters, 230
plaited filter, 231
Food and Drugs Acts, National and State, 27
chemical, 345
Foot bellows, 137
Formaldehyde solution with soap, 315
Formates elixir, **411**
compound, **411**
Formic acid spirit, **391**
Formula for aromatic waters, general, 305
decoctions, general, 457
for fluidextracts, general, 524
infusions, general, 449
tinctures, general, 463
Formulas, chemical, 33
symbolic, 33
Fractional crystallization, 261.
distillation, 179
percolation, 284, 298, 523
Frangula fluidextract, **546**
French Pharmacopœia, 26
Fresh drugs, tincture, 496
plant extracts, 606
Fruit, celery, fluidextract, **566**
parsley, oleoresin, **600**
Fucus fluidextract, **578**
Fuel, 116
Funnel, Bartlett's, 236
for filter, 233
hot water, 238
jacketed hot water, 238
stand, 235
tube, 166
with valve, 236
Funnels, 233
Berlinware, 234
glass, 234
hard rubber, 234
plain, 234
porcelain, 234
queensware, 234
ribbed, 233
separating, 249
tinned-copper, 234
Furnace, crucible, **137**
Furnaces, pharmaceutical, 117
Fusible bodies, Bensemann's method of collecting, 128
Fusion, 138

G.

Galega fluidextract, **578**
Gallon, 43
Gambir, tincture, compound, **479**
Game's still, 173
Gannal's method of taking the specific gravity of a liquid, 89
Gargarisma guaiaci compositum, **371**
Gargarismæ, 371
Gargle of guaiac, compound, **371**
Gargles, 301, 371
Garlic syrup, **334**
Gas, 122
blowpipe, 137
Gas crucible furnace, 137
Gas flame, 122
generator, 220
Gases in solution, 220
Gasoline, 121
stove, 120
stove burner, 121
Gaultheria spirit, **385**
Gay-Lussac's centesimal alcohol-meter, 87
hydrometer, 83
Gel (colloidal), 221
Gelatin for clarifying, 246
Gelsemium extract, **625**
fluidextract, **546**
tincture, **479**
General Committee, U. S. P., 28
formula for decoctions, 457
formula for infusions, 449
formula for tinctures, 463
process for fluidglycerates, 591
fluidextracts, 521, 523, 524, 527
waters, 305
Generation of heat, 116
Generator for gas, 220
Gentian and ferric phosphate elixir, **413**
elixir, **412**
glycerinate, **413**
extract, **626**
fluidextract, **547**
infusion, compound, **455**
iron elixir, **412**
rhubarb tincture, **510**
tincture, compound, **480**
George's double screw press, 274
Geranium fluidextract, **578**
German Pharmacopœia, 26
single screw press, 272
Gigot's press, 271
Ginger fluidextract, **565**
oleoresins, **601**
syrup, **334**
tincture, **495**
Glass evaporating dish, 152
funnels, 234
graduated measures, 74
measures, 73
medicine, 45
syringe, 249
tank, Appert, 261
Globe separator, 249
Glonoin, spirit, **389**
Glucose syrup, **325**
Glycerin, 213
alum, **374**
as solvent, 213
bath, 139
borax, **374**
boric acid, **375**
lead subacetate, **374**
liquids, 301
pepsin, **378**
phenol, **376**
starch, **374**
tannic acid, **374**
Glycerinated elixir of gentian, 413

Glycerinum aluminis, 374
boracis, 374
plumbi subacetatis, 374
Glycerita, 373
Glycerite of alum, 374
bismuth, 376
borax, 374
boroglycerin, 375
carbolic acid, 376
egg yolk, 379
golden seal, 375
guaiac, 377
hydrastis, 375
lead subacetate, 374
pepsin, 378
phenol, 376
phosphates of iron, quinine and strychnine, 374
starch, 374
tannic acid, 374
tannin, 374
tar, 378
tragacanth, 378
Glycerites, 301, 373
questions, 381
Glyceritum acidi tannici, 373, 374
amyli, 373, 374
bismuthi, 373, 376
boroglycerini, 373, 375
ferri, quininæ et strychninæ phosphatum, 374
guaiaci, 373, 377
hydrastis, 373, 375
pepsini, 373, 378
phenolis, 373, 376
picis liquidæ, 373, 378
tragacanthæ, 373, 378
vitelli, 373, 379
Glycerogelatins, 301, 647
Glycerophosphates, calcium and sodium, elixir, 404
elixir, 404
compound, 413
solution, compound, 413
Glyceryl trinitrate spirit, 389
Glyconin, 379
Glycyrrhiza elixir, 400
aqueous, 414
aromatic, 414
extract, 626
pure, 627
fluidextract, 547
fluidglycerate, 593
mixture, compound, 363
syrup, 342
Godfrey's cordial, 369
Golden seal extract, 627
fluidextract, 550
glycerite, 375
tincture, 481
Graduate hook, 74
Graduated evaporating dish, 157
tube for specific gravity, 79
Graduates, conical, 74
cylindrical, 74
double graduation, 75
glass, 74
metric, 74
Graduates, minim, 75
tumbler shaped, 74
Graduation of thermometers, 128
grain, 44
alcohol, 119
Gramme, 47
origin, 45
table, 46
Granular, 252
Granulated effervescent, salts, 264
Granulation, 147
and exsiccation, 264
questions, 268
Grating, 191
Gravity, specific, 78
Greek Pharmacopœia, 26
Green drugs, fluidextracts, 528
extract of belladonna, 606
hyoscyamus, 606
hellebore fluidextract, 563
soap, tincture, 433
compound, 435
Griffith's mixture, 366
Grindelia fluidextract, 549
Grinding, 192
Grooved rollers, 194
Grommets, 158
Growing crystals, 259
Guaiac gargle, compound, 371
glycerite, 377
mixture, 362, 367
tincture, 480
ammoniated, 481
compound, 502
Dewees' 502
Guaiacol petrox, 442
petroxolin, 442
Guarana fluidextract, 549
elixir, 414
Guttæ pectorales, 507

H.

Hadden's filter, 236
Hager's subliming apparatus, 181
Hamamelis fluidextract, 579
tincture, 468
virginiana, 309
water, 309
Hance's mill, 200
percolator, 293
Hand drug mills having horizontal grinding surfaces, 200
with vertical grinding surfaces, 198
Hand scales, 62
Hard rubber funnel, 235
spatulas, 205
Hardesty syrup percolator, 319
vanilla percolator, 294
Hartshorn liniment, 432
Heat, effect on solution, 211
for clarifying, 245
from electricity, 125
from gas, 122
from liquid, 119
generation, 116
Heat, measuring, 126
operations requiring, 116
questions on, 134, 146
uses, 136
Heater for water, 125, 126
Heavy precipitates, 253
Hecto, 45
Helianthemum fluidextract, 579
Hellebore, green fluidextract, 563
Helonias fluidextract, 579
Hematoxylon extract, 639
Henbane fluidextract, 551
tincture, 482
Hensel syrup percolator, 319
Heroine and terpin hydrate elixir, 423
Hessian crucible, 137
Hexagonal, or rhombohedric system, 256
prism, 257
pyramidal summits, 257
(truncated), 257
Hippocrates' sleeve strainer, 226
Hive syrup, 333
Hobbs' graduates, 74
Hodgson's graduates, 74
Hoffmann's anodyne, 391
drops, 385
pinchcock, 170
Honey and borax, 352
clarified, 351
of rose, 351
and borax, 351
and sodium borate, 351
of sodium borate, 352
Honeys, 301, 350
questions, 380
Hoods, 157
Hook for graduates, 74
Hope's mixture, 364
Hops elixir, 415
fluidextract, 579
tincture, 502
Horizontal steam coil, 145
Horn stirrer, 153
Horseradish spirit, compound, 385
Hot drops, 499
extraction apparatus, 296
filtration, 238
water funnel, 238
heater, 126
Hughes electric stove, 125
Hungarian Pharmacopœia, 26
Hunter's sifter, 206
Hydrangea fluidextract, 580
Hydrastis extract, 627
fluidextract, 550
glycerite, 375
tincture, 481
Hydraulic press, 270, 276
Hydriodic acid syrup, 327
Hydrochlorophosphate, calcium, syrup, 337
syrup, compound, 345
Hydrometer, Baume's, 83
Beck's, 87

Hydrometer, Cartier's, 83, 87
Dica's, 87
Fahrenheit's, 83, 87
Gay-Lussac's, 83, 87
jar, 85
Jones', 87
Morveau's, 83
Nicholson's, 83, 88
scale, 84
Sikes', 87
Tralles', 86
Twaddell's, 83, 87
with specific gravity scale, 84
Zanetti's 83, 87
Hydrometers, 83
Hydrosol, 221
Hydrostatic balance, 78
or hydraulic press, 276
Hygroscopic, 261
Hyoscyami tinctura P.I., 482
Hyoscyamus extract, 628
green, 606
fluidextract, 551
oil, compound, 602
infused, 602
tincture, 482
Hypophosphite, ammonium syrup, 335
calcium elixir, 404
syrup, 337
ferric elixir, 409
syrup, 340
sodium elixir, 421
syrup, 349
Hypophosphites and cinchona elixir, 407
calcium and potassium, syrup, 336
compound syrup, 343
elixir, 415
and iron, 415
syrup, 329
with cod liver oil emulsion, 358

I.

Iceland moss decoction, 458
Ignatia extract, 639
tincture, 503
Ignition, 138
Illustrations, Pharmacopœial, 36
Immiscible liquids, separating, 249
questions, 254
Imperial weights and measures, 42, 44
Improvised funnel tube, 167
Incineration, 138
Indian cannabis extract, 621
gum mucilage, 353
podophyllum, tincture, 468
squill vinegar, 603
Infusa, 449
Infused oil of hyoscyamus, 602
oils, 301, 601, 602
Infusion, 269
alstonia, 456
bearberry, 456
Infusion, brayera, 454
broom, 456
buchu, 456
calumba, 456
cascarilla, 456
chiretta, 456
cinchona, 454
cloves, 456
digitalis, 453
ergot, 456
gentian, compound, 455
jars, 450
krameria, 456
orange peel, 456
compound, 456
quassia, 456
rhubarb, 456
rose, compound, 455
sage, 456
senega, 456
senna, 456
compound, 454
wild cherry, 455
Infusions, 301, 449
from fluidextracts, 453
general formula, 449
preservation, 452
Infusum alstoniæ, 456
aurantii, 456
compositum, 456
brayeræ, 451, 454
buchu, 456
calumbæ, 456
caryophylli, 456
cascarillæ, 456
chiratæ, 456
cinchonæ, 452, 454
digitalis, 451, 453
ergotæ, 456
gentianæ compositum, 452, 455
krameriæ, 456
pruni virginianæ, 452, 455
quassiæ, 456
rhei, 456
rosæ compositum, 451, 455
salviæ, 456
scoparii, 456
senegæ, 456
sennæ, 456
compositum, 451, 454
uvæ ursi, 456
Insoluble substances, 211
Inspissated juices, 606
Intermediate crystallization, 262
International Conference for the Unification of Potent Remedies, 27
disk filter, 242
Protocol, 27
Interstitial water, 261
Inunctions, 301, 647
Iodide, ammonium liniment, 434
calcium, syrup, 337
ferrous, syrup, 328
iron and manganese, syrup, 340
potassium, liniment, with soap, 431
Iodine, collodion, 429
petrox, 5 per cent., 443
10 per cent., 443
petroxolin, 443
diluted, 443
tincture, 482
Churchill's, 503
decolorized, 504
stronger, 503
Iodoform collodion, 429
petrox, 443
petroxolin, 443
Iodotannin, syrup, 343
Ipecac and opium syrup, 344
fluidextract, 551
syrup, 329
tincture, 504
wine, 517
I., Q. & S. elixir, 411
Irish moss mucilage, 353
Iron and beef wine, 515
and calcium lactophosphate syrup, 338
citrate wine, 516
crucibles, 137
dialyzed, 268
hypophosphites elixir, 415
lactate, elixir, 410
lactophosphate, syrup, 341
malate crude, 638
tincture, 502
manganese iodide, syrup, 340
mixture, compound, 366
protochloride, syrup, 341
quinine and strychnine elixir, 411
phosphate, syrup, 341
saccharated, soluble, syrup, 342
wine, 516
bitter, 516
Isomorphous, 255
Ispaghula decoction, 458
Italian Pharmacopœia, 26

J.

Jaborandi fluidextract, 554
Jacketed hot water funnel, 238
Jackson's pectoral syrup, 344
Jalap extract, 640
fluidextract, 580
resin, 643
tincture, 504
compound, 505
Jamaica ginger tincture, 495
Japanese lambik, 160
Pharmacopœia, 26
Jar precipitating, 253
Jars for infusions, 450
Joints, bladder and rubber, 164
Jones' hydrometer, 87
mixer and sifter, 205
Juglans fluidextract, 580
Juices, inspissated, 606
Juniper and potassium acetate, elixir, 419
berries fluidextract, 581

Juniper spirit, 389
compound, 390

K.

Kaladana tincture, 468
Kava fluidextract, 581
Kentish's ointment, 434
Kerosene, 121
Kettle, enamelled, 144
steam, 143, 144, 145
Kilo, 45, 47
Kilogramme, 47
King's American Dispensatory, 38
Kino and opium tincture, compound, 505
tincture, 483
compound, 505
Knife edges, 61
roller, 190
Kola fluidextract, 581
Krameria extract, 640
fluidextract, 581
fluidglycerate, 593
infusion, 456
syrup, 344
tincture, 505

L.

Lactate, iron, elixir, 410
Lactometer, 86
Lactophosphate, calcium, elixir, 404
syrup, 328
with emulsion of cod liver oil, 357
iron and cinchona, elixir, 408
iron, syrup, 341
Lactucarium, syrup. 330
tincture, 483
Lafayette mixture, 366
Lambik, 161
Japanese, 160, 161
Laminar, crystals, 255
Lamotte's drops, 501
Lamp, blast, Russian, 119
spirit or alcohol, 119
Lappa fluidextract, 582
Larkspur tincture, 500
Latin title, official, 29
Laudanum, 486
Sydenham's, 506
Lavender spirit, 390
compound, 484
tincture, compound, 484
Laxative elixir, 405
species, 459
Lead and opium lotion, 372
Lead and opium wash, 372
subacetate glycerite, 374
Leaves, belladonna, extract, 619
chestnut, fluidextract, 569
hamamelis, fluidextract, 579
mullein, fluidextract, 590
Lemon peel, tincture, 484
spirit, 385
syrup, 325
Length, metric measures, 47
unit, metric, 45
Leptandra extract, 640
Leptandra fluidextract, 582
Lever press, 275
Levigation, 207
Lewin's extraction apparatus, 296
Licorice elixir, 400
aqueous, 414
aromatic, 414
extract, 626
fluidextract, 547
fluidglycerate, 593
syrup, 342
Liebig condenser, 169
Lime liniment, 432
phosphate with cod liver oil emulsion, 358
syrup, 325
Liniment, aconite, 431
and chloroform, 434
ammonia, 432
ammonium iodide, 434
belladonna, 432
camphor, 432
ammoniated, 431
Canada, 434
chloroform, 433
croton oil, 436
compound, 436
hartshorn, 432
lime, 432
mercury, 431
mustard, compound, 435
opium, 431
compound, 434
potassium iodide with soap, 431
soap, 433
camphorated, 434
soft soap, 433
compound, 435
St. John Long's, 436
Stokes', 436
turpentine, 434
acetic, 436
volatile, 432
white, 436
Linimenta, 430
Liniments, 301, 430
Linimentum aconiti, 431
et chloroformi, 430,434
album, 436
ammoniæ, 430, 432
ammonii iodidi, 430, 434
belladonnæ, 430, 432
calcis, 430, 432
camphoræ, 430, 432
ammoniatum, 431
chloroformi, 430, 433
crotonis, 436
hydrargyri, 431
opii, 431
compositum, 431, 434
potassii iodidi cum sapone, 431
saponato camphoratum, 431, 435
saponis, 430, 433
mollis, 430, 432
compositum, 431,435
sinapis compositum, 431, 435
terebinthinæ 430, 434
aceticum, 431, 436
Linimentum tiglii, 431, 436
compositum, 431, 436
Liquid apiol, 600
measures, 73
opodeldoc, 433
petrox, 441
petroxolin, 441
Liquids, 301
balance for, 67
immiscible, separation, 249
made, by percolation or maceration, 301
without percolation or maceration, 301
measuring, 73
used for heat, 119
Liquor acidi arsenosi, 312
chromici, 315
adrenalini hydrochloricus, 315
alumini acetatis, 314
acetico-tartratis, 314
subacetatis, 314
ammoniæ anisatus, 391
ammonii acetatis, 312
citratis, 314
antisepticus, 313
alkalinus, 313
arsenatis, Pearson, 313
arseni et hydrargyri iodidi, 312
arsenicalis, Clemens, 314
atropinæ sulphatis, 315
auri et arseni bromidi, 314
bismuthi, 313
et ammonii citratis, 315
bromi, 313
calcis, 312
chlorinatæ, 315
sulphuratæ, 314
carmini, 313
chlori compositus, 314
cocci, 313
cresolis compositus, 312
epispasticus, 315
ferri acetatis, 314
albuminati, 314
chloridi, 312
citratis, 314
et ammonii acetatis, 312
hypophosphitis, 313
nitratis, 314
oxychloridi, 314
oxysulphatis, 314
peptonati, 314
et mangani, 314
perchloridi, 315
protochloridi, 314
salicylatis, 314
subsulphatis, 312
tersulphatis, 312
formaldehydi, 312
saponatus, 315
guttæ perchæ, 313
hydrargyri et potassii iodidi, 313
nitratis, 314
acidus, 315
perchloridi, 315
hydrastinæ compositus, 313

Liquor hydrogenii dioxidi, 312
hypophosphitum, 313
compositus, 313
hypophysis, 312
iodi compositus, 312
phenolatus, 313
magnesii bicarbonatis, **315**
citratis, 312
sulphatis effervescens, 313
morphinæ acetatis, **315**
hydrochloridi, **315**
tartratis, **315**
pancreatini, 313
pepsini, 313
antisepticus, 313
aromaticus, 313
phosphatum acidus, 314
compositus, 314
phosphori, 313
picis alkalinus, 313
carbonis, 313
plumbi subacetatis, 312
dilutis, 312
potassæ chlorinatæ, 314
potassii arsenitis, 312
citratis, 312
hydroxidi, 312
permanganatis, **315**
sodæ chlorinatæ, 312
et menthæ, 313
sodii arsenatis, 312
boratis compositus, 313
chloridi physiologicus, 312
citratis, 314
citro-tartratis effervescens, 314
glycerophosphatis, 312
hydroxidi, 312
phosphatis compositus, 313
silicatis, **315**
strychninæ acetatis, 314
hydrochloridi, **315**
zinci chloridi, 312
et alumini compositus, 313
ferri compositus, 313
Liquores, 311
Liter, 47
origin, 45
table, 46
Lithium bromide elixir, **416**
citrate, elixir, **416**
salicylate, elixir, **416**
Lixiviation, 280
Lobelia fluidextract, **552**
tincture, **485**
ethereal, **468**
Lobeliæ tincture P. I., **485**
L'Officine Dervaults, 27
Logwood decoction, **458**
Loss in drying medicinal substances, 187
weight in drugs through drying, 188
Lotio ammoniacalis camphorata, 371, **372**
flava, 371, **372**
nigra, 371, **372**
Lotio plumbi et opii, 371, **372**
Lotion, black, **372**
of lead and opium, **372**
yellow, **372**
Lotiones, 222, 301, 371
Lotions, questions, 381
Lovi's beads, 82
Low temperature processes, 139
Lupulin fluidextract, **582**
oleoresin, **600**
Lutes, 164
Lux's aspirator, 240
Lysimeter, 214, 215

M.

Maceration, 284
and expression, 269
before percolating, 287
circulatory, 269
or digestion, 318
Magma, 252
bismuthi, 370
ferri hydroxidi, 370
magnesiæ, 370
Magmas, 301, 370
questions on, 381
Magnesia, asafetida and opium mixture, **367**
magma, 370
Magnesium bicarbonate solution, 315
Malate of iron, crude, **638**
tincture, **502**
Male fern oleoresin, **599**
Malt extract, **629**
with cod liver oil emulsion, **358**
Manganese and iron iodide, syrup, **340**
Manna syrup, **344**
Marble mortars, 192
Masses, 647
Materia medica, 25
Mathematical problems, 95
answers, 108
Matico fluidextract, **582**
tincture, **468**
Max mill, 197
Mead's disintegrator, 197
Measure, apothecaries', 44
wine, 44
Measures, approximate, 45
enamelled, 73
equivalents, metric, 50
gallon, 73
glass, 73
Imperial, 42, 44
laboratory, 73
liquid, 41, 73
metric, 73
minim, 75
tinned-copper, 73
Measuring, 60
evaporation, 157
heat, 126
liquids, 73
Mediæval weights, 41
Medicated oils, 301, 447
petroxolins, 440
syrup, 317
Medicated wines, 512
Medicine glass, 45
Mel, 350
boracis, **352**
depuratum, 350, **351**
rosæ, 350, 351
boratis, 352
et sodii boratis, 350, **351**
Mellita, 350
Melting points, 128, 130, 132
table, 132
Meniscus, 76
Menisperma fluidextract, **534**
Menstrua selection, 288
Menstruum, 269, 281
adding, 287
Menthol petrox, **444**
petroxolin, **444**
spray, **446**
compound, **446**
Mercuric chloride solution, **315**
nitrate solution, **315**
Mercury liniment, **431**
oleate, **437**
petrox, **443**
petroxolin, **443**
Metallic weights, 70
Meter, 47
origin, 45
table, 46
Method for determining absorbing gas, 220
boiling points, 148
congealing points, 133
effecting precipitation, 252
folding filtering paper, 230
measuring heat, 126
melting points, U. S. P. IX., 130
solubilities, 214.
obtaining crystals, 258
preparing syrups, 317
supporting percolators, 296
Methyl alcohol, 119
salicylate petrox, **444**
petroxolin, **444**
Metric capacity measures, 47
diagram, 46
equivalents, 48, 49, 50
graduates, 74
length measures, 47
table, 46
liquid measure table, 46
system, 45
terms, reading, writing, pronouncing, 59
unit of capacity, 45
length, 45
weight, 45
weight and measure equivalents, 5
measures, 47
table, 46
weights, 72
Metrology, 41
questions, 112
Mexican Pharmacopœia, 26

Mezereum fluidextract, 583
Micromillimeter, 46
Micron, 46
Microscopy, 25
Mil, 47
Milk for clarifying, 246
of almond, **355**
asafetida, **356**
Mill, barrel, 196
Bogardus, 197
buhrstone, 193
chaser, 194
Enterprise, 199
Hance, 200
hand, 198
jar, 195
Max, 197
pebble, 195
Quaker City, 200
roller, 194
Swift's, 198
B, 200
Thomas', 200
Troemner's, 199
Milli, 45
Milligramme, 47
Milliliter, 47
Millimeter, 46
Mills, 193
rules for operating, 201
with iron grinding surfaces, 196
Mineralogy, 25
Minim pipette, 75
graduate, 75
Mistura
adstringens, 361, **363**
et escharotica, **363**
ammonii chloridi, 361, **364**
antidysenterica, **364**
camphoræ acida, 361, **364**
aromatica, 361, **364**
carminativa, 361, **364**
chloralis et potassii bromidi composita, 361, **365**
chloroformi et cannabis indicæ composita, **365**
chloroformi et morphinæ composita, 361, **365**
copaibæ, 361, **366**
et opii, 361, **366**
cretæ, 360, **363**
ferri composita, 361, **366**
glycyrrhizæ composita, 360, **363**
guaiaci, 361, 362, **367**
magnesiæ asafœtidæ et opii, 361, **367**
et asafœtidæ, **367**
olei picis, 361, **367**
oleo-balsamica, 362, **368**
opii alkalina, **369**
et chloroformi composita, 362, **368**
rhei composita, 362, **368**
sassafras, 362, **369**
pectoralis, Stokes', 362, **369**
picis liquidæ, **367**
rhei alkalina, 362, **369**
composita, 362, **370**
Mistura et sodæ, **370**
sassafras et opii, **369**
sennæ composita, **362**
solvens simplex, **364**
Misturæ, 360
Mitchell's alcohol lamp, 120
separator, 250
Mixer and sifter, Jones', 205
Hunter's, 206
Mixture, ammonium chloride, 364
astringent, **363**
brown, **363**
camphor, acid, **364**
aromatic, **364**
Parrish's, **364**
carminative, **364**
chalk, **363**
Chapman's, **366**
chloral and potassium bromide compound, **365**
chloroform and morphine compound, **365**
cholera, Sun, **368**
copaiba, **366**
and opium, **366**
diarrhœa, Squibb's, **368**
glycyrrhiza, compound, **363**
Griffith's, **366**
guaiac, 362, **367**
Hope's, **364**
iron, compound, **366**
Lafayette, **366**
magnesia, asafetida and opium, **367**
oil of tar, **367**
oleo-balsamic, **368**
opium and chloroform, compound, **368**
rhubarb, **368**
sassafras, **369**
rhubarb, alkaline, **369**
and soda, **370**
compound, **370**
senna, compound, **362**
tar, **367**
Villate's, **363**
Mixtures, 301, 360
questions, 381
Ml., 47
Moderately coarse powder, 207
fine powder, 207
Modern weights, 41
Mohr's apparatus, 88
pinchcock, 170
specific gravity apparatus, 88
Moistening drugs for percolation, 285
powder, 285
Monoclinic octahedron, 257
or oblique prismatic system, 257
prism, 257
(partly truncated), 257
pyramidal summits, 257
Mortar and pestle (on a mortar block), 191
block, 191
for trituration, 202
triturating Rice's, 203
Morphine acetate solution, **315**
and acacia syrup, **344**
and chloroform, compound mixture, **365**
and chloroform, compound tincture, **468**
hydrochloride solution, **315**
tartrate solution, **315**
Morton's Bunsen burner, 123
Mother liquor, 261
Mucilage of acacia, **353**
chondrus, **353**
elm, **353**
Indian gum, **353**
Irish moss, **353**
sassafras pith, **353**
tragacanth, **354**
Mucilages, 301, 352
questions, 380
Mucilago acaciæ, 352, **353**
chondri, 352, **353**
gummi Indici, **353**
sassafras medullæ, 352, **353**
tragacanthæ, 352, **354**
ulmi, **353**
Mug, decoction, 456
Mugs for infusions, 450
Mullein leaves, fluidextract, **590**
Muller, 207
Mulls, 301
Musk root fluidextract, **561**
tincture, **485**
Muslin strainers, 227
Mustard, liniment, compound, **435**
spirit, **393**
Myrcia, spirit, compound, **392**
Myria, 45
Myristica spirit, **385**
Myrrh and aloes tincture, **496**
capsicum tincture, **499**
tincture, **485**

N.

Narrow percolator, 284
National Dispensatory, 38
Food and Drugs Act, 27
Formulary, 37
Natural philosophy, 25
Nebula aromatica, 445, **446**
eucalyptolis, 445, **446**
mentholis, 445, **446**
composita, 445, **446**
thymolis, 445, **447**
Nebulæ, 445
Needles' vacuum percolator, 526
Neutralizing cordial, **369**
New essay instrument, 87
Nicholson's hydrometer, 88
Nitre, sweet spirit, **385**
Nitroglycerin spirit, **389**
Nitrous ether, spirit, **385**
Nomenclature, 29
Norwegian Pharmacopœia, 26

Notched cork, 286
Nucis vomicæ extractum P. I., 629
Nuclei for crystals, 259
Number of powder, 207
six, Thomsonian, 439
Numbering on thermometers, 128
Nursing, 259
Nutgall tincture, 502
Nutmeg spirit, 385
Nux vomica and phosphorus elixir, 419
extract, 629
fluidextract, 553
tincture, 486

O.

Octahedron, 256
Official abbreviations, 32
definition, 34
description, 35
English title, 31
infusions made by maceration, 451
percolation, 452
Latin title, 29
percolator, 282
pharmacopœias, 26
preparations, 301
synonyms, 32
Oil bath, 139
camphorated, 432
carbolized, 447
Carron, 432
castor, aromatic, 447
emulsion, 359
cod liver, emulsion, 356
with calcium lactophosphate, 357
with calcium phosphate, 358
with egg, 359
with hypophosphites, 358
with malt, 358
with wild cherry, 359
croton, collodion, 429
liniment, 436
compound, 436
hyoscyamus, compound, 602
infused, 602
phenolated, 447
phosphorated, 447
spray, aromatic, 446
sugars, 301, 647
tar mixture, 367
turpentine emulsion, 356
Oils, 214
as solvents, 214
infused, 601, 602
volatile, spirit, 393
Oily liquids, 301
questions, 605
Ointment, Kentish's, 434
Ointments, 301, 647
Oldberg's percolator, 284
Olea infusa, 602
Oleaginous solutions, 301, 430
questions, 448
Oleata, 436
Oleate of aconite, 43
atropine, 438
cocaine, 438
mercury, 437
quinine, 439
veratrine, 439
zinc, 437
Oleates, 301, 436
Oleatum aconitinæ, 437, 438
atropinæ, 437, 438
cocainæ, 437, 438,
hydrargyri, 437
quininæ, 437, 439
veratrinæ, 437, 439
zinci, 437
Oleo-balsamic, mixture, 368
Oleoresin, of aspidium, 599
capsicum, 599
cubeb, 600
ginger, 601
lupulin, 600
male fern, 599
parsley fruit, 600
pepper, 601
Oleoresina aspidii, 599
capsici, 599
cubebæ, 599, 600
lupulini, 599, 600
petroselini, 599, 600
piperis, 599, 601
zingiberis, 599, 601
Oleoresinous liquids, 301
Oleoresins, 301
questions, 605
Oleum carbolatum, 447
hyoscyami, compositum, 602
phenolatum, 447
phosphoratum, 447
ricini aromaticum, 447
Oliver's bark tincture, 468
Open steam bath, 141
Operations requiring heat, 116
Opium and chloroform mixture, compound, 368
and copaiba mixture, 366
and ipecac syrup, 344
and ipecac tincture, 504
and kino tincture, compound, 505
and lead lotion, 372
and lead wash, 372
and rhubarb mixture, compound, 368
and sassafras mixture, 369
extract, 630
liniment, 431
compound, 434
magnesium, and asafetida mixture, 367
tincture, 486
ammoniated, 468
camphorated, 487
deodorized, 488
with saffron, 506
vinegar, 604
Opii extractum P. I., 630
tinctura P. I., 486
benzoici P. I., 487
Opodeldoc, 435
liquid, 433
solid, 435
Orange, bitter, elixir, 402
elixir, compound, 514
flower water, 306
stronger, 307
flowers, syrup, 327
peel, bitter, fluidextract, 538
tincture, 471
infusion, 456
compound, 456
sweet, tincture, 471
spirit, 385
compound, 388
syrup, 327
wine, 519
compound, 514
Orgeat syrup, 325
Origin of avoirdupois weights, 42
of English weights, 41
of gramme, 45
of liter, 45
of meter, 45
Orthography, 59
Orthometric crystals, 255
Oven for drying, 186, 264
method for effervescent salts, 265
Oxgall extract, 625
Oxide of iron, saccharated, syrup, 342
soluble, syrup, 342
Oxymel, 350
of squill, 352
scillæ, 350, 352
Oxymels, 301

P.

Packer for percolator, 287
Packing percolators, 287
Pan for moistening powders, 285
Paper filters, 229
pulp for clarifying, 246
scale thermometer, 127
Papers, 301, 647
Paracoto fluidextract, 583
tincture, 506
Parchment paper, 266
Paregoric, 487
Pareira fluidextract, 583
Parrish's camphor mixture, 364
Parsley fruit oleoresin, 600
root fluidextract, 583
Pascal's law, 277
Passion flower, tincture, 507
Pastes, 301, 647
Patch's tubular boiler, 143
Pattern for Hippocrates' sleeve, 226
Pear-shaped separator, 250
Pebble mills, 195
Pectisation, 221

Pectoral drops, **507**
species, **459**
syrup, Jackson's, **344**
tincture, **507**
Pellitory tincture, **489**
Pencils, 301, 647
Penny, English silver, 41
Pepper, oleoresin, **601**
Peppermint essence, **390**
spirit, **390**
water, **310**
Pepsin and iron elixir, **417**
elixir, **416**
with bismuth, **417**
and strychnine, **417**
iron, **417**
rennin, compound, **418**
essence, **418**
glycerite, **378**
wine, **518**
Percentage, alcoholic, of fluidextracts, 528
Percentages, 102
Percolate, 281
control of flow, 289
rate of flow, 290
Percolating weight, 288
Percolation, 269, 280
closet (Shinn), 297
continuous, 525
in making syrups, 318
fractional, 284, 298, 523
moistening drugs for, 285
on the large scale, 294
process, 283
questions, 299
receiving bottles, 297
through cotton impregnated with the substance, 303
vacuum, 526
with hot extraction, 296
Percolator, 281
conical, 282
covers, 288
cylindrical, 282
double tube, 293
Dursse's, 290
for hot extraction, 296
for syrup, 319
Hardesty, syrup, 319
vanilla, 294
Hensil, syrup, 319
official, 282
packer, 287
packing, 286
pressure, 295
shapes, 284
Squibb, 290
stand, 296
stoppered, 290
supports, 296
suspended, 293
syrup, 319
vanilla, 294
weight, 288
well-tube, 290
Percolators, 282
special, 290
Perfumed spirit, **392**
Pèse-acide, 83
-esprit, 83
Pèse-Sirop, 83
Pestle for triturating, 202
hard rubber handle, 203
loaded for triturating, 203
Petrolatum emulsion, **360**
saponatum liquidum, **441**
spissum, **441**
Petroleum benzin, 121, 213
Petrox, betanaphthol, **441**
cade, **442**
camphorated chloroform, **442**
creosote, **442**
eucalyptol, **442**
guaiacol, **442**
iodine, **443**
diluted, **443**
iodoform, **443**
liquid, **441**
menthol, **444**
mercury, **443**
methyl salicylate, **444**
phenol, **444**
camphorated, **444**
solid, **441**
sulphurated, **444**
compound, **445**
tar, **444**
Venice turpentine, **445**
Petroxolin, betanaphthol, **441**
cade, **442**
camphorated chloroform, **442**
creosote, **442**
eucalyptol, **442**
guaiacol, **442**
iodine, **443**
diluted, **443**
iodoform, **443**
liquid, **441**
menthol, **444**
mercury, **443**
methyl salicylate, **444**
phenol, **444**
camphorated, **444**
solid, **441**
sulphurated, **444**
compound, **445**
tar, **444**
Venice turpentine, **445**
Petroxolina, 439
Petroxolins, 301, 439, 440
Petroxolinum betanaphtholis, 440, **441**
cadini, 440, **442**
chloroformi camphoratum, 440, **442**
creosoti, 440, **442**
eucalyptolis, 440, **442**
guaiacolis, 440, **442**
hydrargyri, 440, **443**
iodi, 440, **443**
dilutum, 440, **443**
iodoformi, 440, **443**
liquidum, 440, **441**
mentholis, 440, **444**
methylis, salicylatis, 440, **444**
phenolis, 440, **444**
camphoratum, 440, **444**
picis, 440, **444**
Petroxolinum, spissum, 440, **441**
sulphuratum, 440, **444**
compositum, 440, **445**
terebinthinæ laricis, 440, **445**
Pharmaceutical, drying closet, 185
furnace, 117, 118
range, 118
still, 173
stills, 171
Pharmacognosy, 25
Pharmacology, 26
Pharmacopœia, preparations, 37
Pharmacopœia, U.S., Spanish Edition, 27
Pharmacopœial illustrations, 36
revision, 28
Pharmacopœias, 26
of the world, 26
Pharmacy, 25
practical, 25, 26
theoretical, 25
Phenol glycerite, **376**
petrox, **444**
camphorated, **444**
petroxolin, **444**
camphorated, **444**
Phenolated, oil, **447**
water, **311**
Philosophy, natural, 25
Phosphate, calcium with cod liver oil emulsion, **358**
ferric and gentian elixir, **413**
elixir, **410**
Phosphates, of iron, quinine and strychnine, elixir, **499**
glycerite, **374**
syrup, **341**
syrup, compound, **345**
with quinine and strychnine, **345**
Phosphorated oil, **447**
Phosphorus, elixir, **418**
with nux vomica, **419**
spirit, **385**
Physics, 25
Physostigma extract, **631**
tincture, **488**
Phytolacca fluidextract, **584**
Picrorhiza tincture, **468**
P. I., 27
Pills, 301, 647
Pilocarpus fluidextract, **554**
Pilular consistence, 608
extract of belladonna leaves, **619**
stramonium, **633**
extracts, 608, 609, 617
Pimpinella, tincture, **508**
Pinchcock (Remington's), 170
Pinchcocks, 170
Pink root fluidextract, **560**
Pipette, minim, 75
specific gravity, 90
Plain blowpipe, 136
filter, 230, 231

Plain funnel, 234
percolator, 284
receiver, 165
retort, 161
Plaited filter, 231
parallel folds, 232
Plasters, 301, 647
Plates and crushers, 200
Platinum crucibles, 137, 138
Plattner's blowpipe, 136
Podophyllin, 644
Podophyllum extract, **641**
fluidextract, **554**
Indian, tincture, **468**
resin, **644**
tincture, **468**
Polymorphous crystals, 255
Pomegranate fluidextract, **548**
Poppy, red, syrup, **325**
syrup, **345**
Porcelain crucibles, 137
evaporating dish, 152
funnels, 234
mortar and pestle, 204
stirrer, 153
Porphyrization, 208
Portuguese Pharmacopœia, 26
Potassium acetate and buchu elixir, **403**
acetate elixir, **419**
and juniper elixir, **419**
bromide and chloral, compound mixture, **365**
elixir, **419**
iodide liniment with soap **431**
permanganate solution, **315**
Potent Remedies, Conference on Unification, 27
Pound, avoirdupois, 43
troy, 42, 43
Powder, coarse, 207
Dover's, syrup, **344**
tincture, **504**
fine, 207
fineness, U.S.P. IX, 206
moderately coarse, 207
fine, 207
sublimates, 182
very coarse, 207
very fine, 207
Powdered extract of aconite, **618**
aloes, **635**
belladonna leaves, **620**
cascara sagrada, **622**
cimicifuga, **622**
colchicum corm, **623**
colocynth, **624**
compound, **624**
euonymus, **638**
gelsemium, **625**
hydrastis, **627**
ignatia, **639**
krameria, **640**
leptandra, **640**
nux vomica, **629**
opium, **630**
oxgall, **625**
physostigma, **631**
Powdered extract of quassia, **641**
rhubarb, **632**
stramonium, **633**
viburnum prunifolium, **635**
extracts, 608, 609, 617
Powders, 647, 301
Practical pharmacy, 25, 26
Precipitant, 252
Precipitate, 252
collecting, 254
chemical, 252
heavy and light, 253
strainer, 254
washing, 254
Precipitating crystals, 260
jar, 253
vessels, 253
Precipitation, 252
methods, 252
questions, 254
Preparation of syrups, 317
Preparations of the Pharmacopœia, 37
official, 301
Prescription balance, 63, 64, 69
scale, pocket, 66
scales, box, 67
strainer, 228
weights, 72
Preservation, 304
extracts, 609
fluidextracts, 527
infusions, 452
syrups, 320
Press, Dudgeon's, 277
enterprise, 273
George's, 274
Gigot's, 271
hydraulic, 270
hydrostatic, 270
lever, 275
roller, 275
screw, 271
single, 272
spiral twist, 271
Troemner's, 272
wedge, 275
Pressure filtration, 242
percolation, 295
percolator (Suits), 295
steam without the use of a boiler, 145
Previous maceration, 287
Prickly ash fluidextract, **564**
Prismatic crystals, 255
Problems, alligation, 101
and exercises, 95
mathematical, 95
answers, 108
percentage, 102
specific gravity, 95, 102
volume, 95
weights and measures, 95
Process of crystallization, 258
of percolation, 283
Procter's still, 171
Production of heavy and light precipitates, 253
Pronunciation, 59
Proper packing, 287
Protochloride of iron, syrup, **341**
Protocol, International, 27
Internationale, 27
Pulsatilla, tincture, 508
Pulverization by intervention, 209
Pulverizing, 192
Pump, Bunsen's, 240
Chapman's, 241
Richards', 241
vacuum, 240, 242
Pumps, vacuum, **154**
water, 241
Pure extract of glycyrrhiza, **627**
Food and Drugs Act, 27
Purity rubric, 34
Pycnometer, 79, 81
Squibb's, 82
Pyknometer, 81
Pyrethrum, tincture, **489**
Pyrophosphate, ferric elixir, **410**
quinine and strychnine, elixir, **410**

Q.

Quaker City F. No. 4 mill, 200
Quassia extract, **641**
fluidextract, **584**
infusion, **456**
tincture, **489**
Quebracho, fluidextract, **537**
Queensware funnels, 234
Quercus fluidextract, **585**
Questions on alcoholic liquids by percolation or maceration, 594
on alcoholic solutions, 425, 426
on aqueous liquids by percolation, and maceration, 459
on aqueous preparations, 379
containing sweet, viscid, or insoluble substances, 379, 380, 381
on clarifying and decoloration, 248
on crystallization, 263
on desiccation and comminution, 210
on distillation and sublimation, 183
on ethereal and oleaginous solutions or those for external application, 448
on expression, 279
on extraction, 270
on extracts and resins, 645
on filtration, 244
on granulation, exsiccation and dialysis, 268
on heat, 134
on Introductory Chapter, 39

Questions on metrology, 112
on oleoresinous, oily and acetous liquids, 605
on percolation, 299
on separating immiscible liquids and precipitation, 254
on solution, 221
on straining, 228
on use of heat, 146
on vaporization, 159
on waters and solutions, 316
Quillaja, tincture, **509**
Quilled receivers, 165
Quinine oleate, **439**
tincture, **468**
ammoniated, **468**
wine, **519**
valerate and strychnine elixir, **420**
Quinidine syrup, **346**

R.

Rack for funnels, 235
Ranges, coal, 117, 118
Rapid filtration, 239, 240
Rasp, 191
and file, 164
Raspberry syrup, **348**
Rasping, 191
or grating, 191
Rat tail file, 164
Rate of flow, 290
Reading metric terms, 59
Reaumur scale, 126
Receiver, Florentine, 250
for light and heavy oils, 250
Receivers, 165
Receiving bottle, 297
flask, 297
Rectified spirit, 385
Red aromatic elixir, **402**
elixir, **402**
Red-poppy syrup, **325**
Remington still, 176
clamp, 168
pinchcock, 170
Rennin and pepsin, elixir, compound, **418**
Repercolation, 284, 298, 523
Resin, 642
of jalap, **643**
of podophyllum, **644**
of scammony, **644**
Resina, 642
jalapæ, **642**, **643**
podophylli, **642**, **644**
scammoniæ, **642**, **644**
Resinæ, **642**
Resins, 301, 642
questions, 646
Retarded crystallization, 259
Retort, 161
principle, 175
ring, 167
clamp, 167
stands, 167
stills, 175
Retorts, 166
Revision of Pharmacopœia, 28
of the National Formulary, 37
Revolving disk and screens, 197
Rhamnus cathartica syrup, **347**
catharticus fluidextract, **585**
purshiana elixir, **405**
extract, **622**
fluidextract, **540**
aromatic, **541**
Rhombic octahedron, 256
prism, 256
pyramidal summits, 256
Rhubarb and gentian tincture, **510**
and opium mixture, compound, **368**
soda mixture, **370**
extract, **632**
fluidextract, **555**
fluidglycerate, **594**
infusion, **456**
mixture, alkaline, **369**
compound, **370**
syrup, **331**
aromatic, **332**
spiced, **332**
tincture, **490**
aqueous, **509**
aromatic, **490**
sweet, **509**
wine, compound, **519**
Rhus glabra fluidextract, **585**
Ribbed funnel, 234
Richards' pump, 241
Rice's lysimeter, 214
Rice's mortar for triturating, 203
still and condenser, 175
Rings for retorts, 167
Ritchie torsion balance, 68
Rod, guiding, 224
Roller knife, 190
mills, 194
press, 275
Root, angelica, fluidextract, **566**
belladonna, fluidextract, **539**
convallaria, fluidextract, **574**
musk, fluidextract, **561**
parsley, fluidextract, **583**
pink, fluidextract, **560**
Rose and sodium borate honey, **351**
fluidextract, **554**
honey, **351**
and borax, **351**
infusion, compound, **455**
syrup, **347**
water, **310**
stronger, **311**
Rosemary spirit, **385**
Rosin, 642
Rotary cutter, 190
stirrer, 153
Rother's filter, 230
Roumanian Pharmacopœia, 26
Rousseau's densimeter, 90
Rubber joint, 165
spatulas, 205
Rubric, purity, 34
Rubus fluidextract, **586**
syrup, **347**
Rule for specific gravity, 78
Rules for converting thermometers, 127
mills, 201
Rumex fluidextract, **586**
Russian blast lamp, 120
Pharmacopœia, 26

S.

Sabal fluidextract, **556**
Saccharated iron, soluble syrup, **342**
oxide of iron, syrup, **342**
powders, **647**
Saccharometer, 86
Safety tubes, 167
Saffron tincture, **500**
Sage infusion, **456**
Sal, 221
Salicylate, lithium, elixir, **416**
sodium elixir, **421**
compound, **421**
Salicylic collodion, compound, **429**
Salt water baths, 139
Salts, effervescent, 264
Sand bath, 139
Sanguinaria fluidextract, **586**
syrup, **348**
tincture, **491**
Santal and saw palmetto, tincture, **510**
Sappan decoction, **458**
Sarsaparilla, decoction, compound, **457**
milder, **458**
stronger, **458**
fluidextract, **557**
compound, **557**
syrup, compound, **332**
Sassafras and opium mixture, **369**
pith mucilage, **353**
Saturated solution, 211
boiling points, 140
solutions, 212
Saw palmetto and santal tincture, **510**
fluidextract, **556**
Scales, ball, 66
care of, 70
compound lever, 67
counter, 65, 67
double beam, unequal arm, 66
for hydrometers, 84
for liquid, 67
hand, 62
prescription, box, 67

Scales, pocket, 67
torsion, 69
single beam, unequal arm, 66
torsion, 68
Scammony resin, 644
Scoop sifter, 206
sieve, 206
Scoparius fluidextract, 586
Scored paper, 286
Screw pinchcock (Hoffmans), 170
press, 271
Scutellaria fluidextract, 587
Secalis cornuti extractum, fluidum, P.I., 544
Sedative water, 372
Seed, colchicum fluidextract, 543
wine, 516
Semi-bituminous coal, 116
Senecio fluidextract, 587
Senega fluidextract, 559
infusion, 456
syrup, 333
tincture, 468
Senna fluidextract, 559
infusion, 456
compound, 454
mixture, compound, 362
syrup, 333
aromatic, 349
compound, 349
tincture, compound, 468
Separating funnel, 249
Separation of fluids from solids, 220
of immiscible liquids, 249
Separator, funnel, 249
globe, 249
Mitchell's, 250
pear-shaped, 250
Serology, 25
Serpentaria fluidextract, 587
tincture, 510
Servian Pharmacopœia, 26
Sheet rubber cover, 288
Sherry wine, 512, 513
Sieve, pharmaceutical, 205
wire cloth, 205
Sieves, 205
bolting cloth, 207
Sifter and mixer, Hunter's, 206
Jones', 205
Sifting, 205
with water, 208
Sikes' hydrometer, 87
Silica crucibles, 137, 138
Silver colloidal, 221
crucibles, 137
elixir, 400
solution, 211
in cold water, 302
solutions (aqueous), 312
syrup, 317, 325
Single beam, equal arm balances, 66
unequal arm balances, 66
screw presses, 272
Siphon, 224
Sirup, 325
Sirups, 317
Slab, 207
Slicing, 189
Stillingia, fluidextract, 561
Snakeroot, black fluidextract, 541
Canada, syrup, compound, 336
Soap, green, tincture, 433
compound, 435
liniment, 433
camphorated, 434
soft, liniment, 433
compound, 435
Sodium and calcium, glycerophosphates, elixir, 404
hypophosphites, syrup, 336
Soda and rhubarb mixture, 370
Sodium borate and rose honey, 351
honey, 352
bromide elixir, 420
hydroxide, 36
hypophosphite elixir, 421
syrup, 349
salicylate elixir, 421
compound, 421
silicate solution, 315
Soft soap, liniment, 433
compound, 435
Solanum fluidextract, 587
Solid handle spatulas, 204
opodeldoc, 435
petrox, 441
petroxolin, 441
Solidified alcohol, 121
Solids, 301
made by percolation or maceration, 301
without percolation or maceration, 301
solution of, 211
specific gravity, 78,80
used for heating, 116
Solubility as a test, 214
determination of, 214
of substances in saturated solutions, 212
table, 215
Soluble oxide of iron, syrup, 342
substances, 211
Solute, 211
Solution, 211
adrenaline, hydrochloride, 315
ammonia, anisated, 391
atropine sulphate, 315
bismuth and ammonium citrate, 315
chemical, 211
chlorinated lime, 315
chromic acid, 315
circulatory, 213
effect of heat, 211
ferric chloride, 315
formaldehyde, with soap, 315
gases in liquids, 220
Solution, glycerophosphates, compound, 413
in hot water, 303
magnesium bicarbonate, 315
mercuric chloride, 315
nitrate, acid, 315
morphine acetate, 315
hydrochloride, 315
tartrate, 315
potassium permanganate, 315
questions, 221
saturated, boiling point, 140
simple, 211
sodium silicate, 315
solids, 211
strychnine hydrochloride, 315
with heat, 318
Solutions, 301, 311
aqueous, 302
colloidal, 221
density, 212
questions, 316
saturated, 212
Solvent, 211
Solvents used in pharmacy, 213
Spanish Edition U. S. Pharmacopœia, 27
Pharmacopœia, 26
Spatula, blade covered with hard rubber, 205
Spatulas, 204
Spearmint spirit, 391
water, 310
Species, 458
ad infusum pectorale, 459
emollient, 459
emollientes, 459
laxantes, 459
laxative, 459
pectoral, 459
Specific gravities, 41,78, 102
apparatus, Mohr's, 88
Westphal, 89
beads, 82
bottle, 79, 81
hydrometer, 84
of a solid, 78
of Pharmacopœial substances, 90
of liquids, 81
of solids, 78
pipette, 90
rule, 78
scale hydrometer, 84
table, 90
tube, 79
volume, 92
bottle, 93
Spiced syrup of rhubarb, 332
Spigelia fluidextract, 560
Spiral twist press, 271
Spirit, ammonia, 384
anisated, 391
aromatic, 386
fetid, 385
anise, 387
ants, 391
bitter almond, 387

Spirit, cajuput, 385
camphor, 388
cardamom, compound, 392
chloroform, 388
cinnamon, 389
Columbian, 119
ether, 385
compound, 391
formic acid, 391
gaultheria, 385
glonoin, 389
glyceryl trinitrate, 389
horseradish, compound, 385
juniper, 389
compound, 390
lamp, 119
lavender, 390
compound, 484
lemon, 385
mustard, 393
myrcia, compound, 392
myristica, 385
nitre, sweet, 385
nitroglycerin, 389
nitrous ether, 385
nutmeg, 385
orange, 385
compound, 388
peppermint, 390
perfumed, 392
phosphorus, 385
rectified, 385
rosemary, 385
spearmint, 391
vanillin, compound, 393
wintergreen, 385
Spirits, 301, 382
volatile oils, 393
Spiritus, 382
acidi formici, 383, 391
ætheris, 382, 385
compositus, 383, 391
nitrosi, 384, 385
ammoniæ, 384
anisatus, 383, 391
aromaticus, 382, 386
fetidus, 385
amygdalæ amaræ, 382, 387
anisi, 382, 387
armoraciæ compositus, 385
aurantii compositus, 382, 388
aurantii, 385
cajuputi, 385
camphoræ, 382, 388
cardamomi compositus, 383, 392
chloroformi, 382, 388
cinnamomi, 382, 389
formicarum, 391
frumenti, 385
gaultheriæ, 385
glycerylis nitratis, 382, 389
juniperi, 382, 389
compositus, 382, 390
lavandulæ, 382, 390
limonis, 385
menthæ piperitæ, 383, 390
viridis, 383, 391
Spiritus myrciæ compositus, 383, 392
myristicæ, 385
odoratus, 383, 392
oleorum volatilum, 393
phosphori, 385
rectificatus, 385
rosmarini, 385
sinapis, 383, 393
vanillini compositus, 383, 393
vini gallici, 385
Spontaneous evaporation, 156
Spray, aromatic oil, 446
eucalyptol, 446
menthol, 446
compound, 446
thymol, 447
Sprays, 301, 445
Spring pinchcock (Mohr's), 170
Springfield laboratory burner, 124
Sprinkler controller, 290
Spritz bottle, 222
Square prism, pyramidal, summits, 256
Squibb's diarrhœa mixture, 368
minim pipette, 75
pinchcock, 170
pycnometer with leaden collar, 82
urinometer, 85
Squill fluidextract, 558
Indian, vinegar, 603
oxymel, 352
syrup, 332
compound, 333
tincture, 491
vinegar, 604
Squires' infusion mug, 450, 451
Stand for apparatus, 168
funnels, 235
Standard for powders, 206
thermometers, 128
Standardizing thermometers, 128, 129
Stands, retort, 167
"Stansico," dissectible balances, 63
Staphisagria fluidextract, 560
Starch glycerite, 374
State Food and Drugs Acts, 27
Stavesacre fluidextract, 560
Steam baths, 141
boiler, 143
coil, 145
distributor, 141
in pharmaceutical operations, 141
Steam kettle, 143
on trunnions, 144
superheated, temperature, 142
under pressure, 142
without pressure, 142
Sterculia fluidextract, 581
Sterling, 41
Sterilization of infusions, 452
Sterilized distilled water, 309
Stevens' still, 173
St. Germain tea, 459
Still, Curtman's, 172
Games', 173
Procter's, 171
Remington, 176
Stevens', 173
top, 177
Wiegand's, 172
Stillingia fluidextract, compound, 588
syrup, compound, 350
Stills, 171
vacuum, 154
Stirrers for evaporation, 152
St. John Long's liniment, 436
Stokes' automatic water still, 179
expectorant, 369
liniment, 436
Stomach drops, 496
Stomachic tincture, 496
Stoppered funnel tube, 166
percolator, 290
Stove, coal oil, 121
electric, 126
gasoline, 120
hood, 158
Stoves, coal, 117
gas, 124
Strainer and frame, 227
cotton flannel, 227
felt, 226
for precipitates, 254
prescriptions, 228
Hippocrates' sleeve, 226
woollen, 226
Straining, 226
carelessness in, 228
questions, 228
Stramonium extract, 632
pilular, 633
powdered, 633
fluidextract, 588
tincture, 468, 492
Stronger orange flower water, 307
rose water, 311
tincture of iodine, 503
Strophanthii tinctura P.I., 492
Strophanthus tincture, 492
Strychni tinctura P.I., 486
Strychnine and quinine valerate elixir, 420
hydrochloride solution, 315
pepsin and bismuth elixir, 417
valerate elixir, 421
Styptic collodion, 429
Sub-committees, U.S.P., 28
Sublimates, cake, 181
powder, 182
Sublimation, 139, 147
crystals by, 258
of benzoic acid, 181
questions, 183

Subliming apparatus (cake), 181
(powder), 182
Sugar for syrups, 317
Suits' pressure percolator, 295
Sulphurated petrox, 444
petroxolin, 444
Sumbul extract, 634
fluidextract, 561
tincture, 511
Sun cholera mixture, 368
Supernatant liquid, 252
Supersaturated solutions for crystals, 258
Supports for percolators, 296
Suppositories, 301, 647
Surface evaporation, 155, 156
Suspended percolator, 293 (Hance's), 293
Swedish Pharmacopœia, 26
Sweet orange peel, tincture, 471
spirit of nitre, 385
tincture of rhubarb, 509
Swift's B mill, 200
mill, 198
Swiss Pharmacopœia, 26
Sydenham's laudanum, 506
Symbolic formula, 33
Synonyms, 32
Syphon, 224
Syringe, glass, 249
pipette, 249
Syrup, 325
acacia, 326
actæa, compound, 338
althæa, 335
ammonium hypophosphite, 335
aromatic, 325
asarum, compound, 336
bitter almond, 325
blackberry fruit, 347
bloodroot, 348
bromides, 336
buckthorn berries, 347
calcium hydrochlorophosphate, 337
hydroxide, 325
hypophosphite, 337
iodide, 337
lactophosphate, 328
and iron, 338
Canada snake-root, compound, 336
cascara, aromatic, 325
chloral, 325
cimicifuga, compound, 338
cinnamon, 339
citric acid, 326
codeine, 339
Dover's powder, 344
Easton's, 341
eriodictyon, aromatic, 339
ferric hypophosphite, 340
ferrous chloride, 341
iodide, 328
phosphate, 325
figs, compound, 342
garlic, 334
Syrup, ginger, 334
glucose, 325
glycyrrhiza, 342
hive, 333
hydriodic acid, 327
hydrochlorophosphates, compound, 345
hypophosphites, 329
compound, 343
iodotannin, 343
ipecac, 329
and opium, 344
iron and manganese iodide, 340
lactophosphate, 341
krameria, 344
lactucarium, 330
lemon, 325
licorice, 342
lime, 325
and sodium hypophosphites, 33 (
manna, 344
morphine and acacia, 344
orange, 327
flowers, 327
orgeat, 325
pectoral, Jackson's, 344
percolator, 319
phosphates, compound, 345
iron, quinine and strychnine, 341
with quinine and strychnine, 345
poppy, 345
protochloride of iron, 341
quinidine, 346
bitterless, 346
raspberry, 348
red-poppy, 325
rhamnus cathartica, 347
rhubarb, 331
aromatic, 332
spiced, 332
rose, 347
rubus, 347
saccharated oxide of iron, 342
sanguinaria, 348
sarsaparilla, compound, 332
senega, 333
senna, 333
aromatic, 349
compound, 349
simple, 325
sodium hypophosphite, 349
soluble oxide of iron, 342
saccharated iron, 342
squill, 332
compound, 333
stillingia, compound, 350
tar, 330
tolu, 333
white pine, compound, 346
with morphine, 346
wild cherry, 331
yerba santa, aromatic, 339
Syrups, 301, 317
by percolation, 318
official, 320
preparation, 317
preservation, 320
questions, 379
Syrupus acaciæ, 321, 326
acidi citrici, 321, 326
hydriodici, 321, 327
allii, 323, 334
althææ, 323, 335
ammonii hypophosphitis, 332, 335
amygdalæ, 325
aromaticus, 325
asari compositus, 323, 336
aurantii, 321, 327
florum, 321, 327
bromidorum, 322, 336
calcii et sodii hypophosphitum, 323, 336
chlorhydrophosphatis, 337
hydrochlorophosphatis, 322, 337
hypophosphitis, 323, 337
iodidi, 323, 337
lactophosphatis, 321, 328
cum ferro, 323, 338
et ferri, 338
calcis, 325
cascaræ aromaticus, 325
chloral, 325
cimicifuga compositus, 324, 338
cinnamomi, 323, 339
corrigens, 339
codeinæ, 322, 339
eriodictyi aromaticus, 324, 339
ferri et mangani iodidi, 323, 340
hypophosphitis, 324, 340
iodidi, 322, 328
lactophosphatis, 322, 341
oxydati solubilis, 342
phosphatis, 325
protochloridi, 322, 341
quininæ et strychninæ phosphatum, 322, 341
saccharati solubilis, 323, 342
ficorum compositus, 324, 342
glucosi, 325
glycyrrhizæ, 323, 342
hydrochlorophosphatum, 345
hypophosphitum, 321, 329
hypophosphitum compositus, 323, 343
iodotannicus, 324, 343
ipecacuanhæ, 321, 329
et opii, 323, 344
krameriæ, 323, 344
lactucarii, 323, 330
limonis, 325

Syrupus, mannæ, 324, **344**
morphinæ et acaciæ, 322, 344
papaveris, 324, **345**
pectoralis, **344**
phosphatum compositus, 322, **345**
cum quinina et strychnina, 322, **345**
picis liquidæ, 321, **330**
pini strobi compositus, 324, **346**
cum morphina, 322 **346**
pruni virginianæ, 321, **331**
quinidinæ, 322, **346**
rhamni catharticæ, 323, **347**
rhei, 321, **331**
aromaticus, 321, **332**
et potassii compositus, **369**
rhœados, **325**
rosæ, 324, **347**
rubi, 323, **347**
fructus, 324, **347**
idæi, 324, **348**
sanguinariæ, 324, **348**
sarsaparillæ compositus, 321, **332**
scillæ, 322, **332**
compositus, 321, **333**
senegæ, 321, **333**
sennæ, 321, **333**
aromaticus, 324, **349**
compositus, 323, **349**
sodii hypophosphitis, 323 **349**
spinæ cervinæ, **347**
stillingiæ compositus, 323, **350**
tolutanus, 322, **333**
zingiberis, 322, **334**
System, decimal, 45
metric, 45

T.

Table, apothecaries' measures, 44
weights, 43
approximate measures, 45
avoirdupois weights, 43
boiling or distilling points of official substances, 149
points of saturated solutions of various salts, 140
British Pharmacopœial waters, 311
drop equivalents, 77
extracts, 612
fluidextracts, 529
gramme, 46
honeys, 350
Imperial measure, 44
liter, 46
loss in powdering drugs, 188
melting points of official substances, 132
meter, 46
Table, metric and old form equivalents, 50
length, 46
liquid measure, 46
weights, 46
mucilages, 352, 353
specific gravities, 90
solubility of official substances in water and in alcohol, 215
solutions, 312, 315
syrups, 321, **325**
temperatures of superheated steam, **142**
tinctures, 464
troy weights, 43
vinegars, 603
waters, 302, 311
weight and volume relation, 94
wine measure, 44
wines, 513
Tablespoonful equivalent, 45
Tablets, 301, 647
Tabular crystals, 255
Tank, glass, Appert, 261
Tannic acid glycerite, **374**
Tannin glycerite, **374**
Tar glycerite, **378**
mixture, **367**
oil mixture, **367**
petrox, **444**
petroxolin, **444**
syrup, **330**
wine, **518**
Taraxacum, elixir, compound, **422**
extract, **634**
fluidextract, **562**
Tea, breast, **459**
St. Germain, **459**
Teas, 301, 458
Teacupful equivalent, 45
Teaspoonful equivalent, 45
Tenaculum, 227
Tension of vapors, 150
Terpin hydrate elixir, **422**
and codeine, **422**
diacetyl morphine, **423**
Testing a balance, 61
Tests through solubility, 214
Theoretical pharmacy, 25
Thermometer, auxiliary, 129
for boiling points, **149**
Thermometers, 126
clinical, 128
for boiling points, 129
graduation of, 128
numbering, 128
rules for converting, **127**
standard, 128
standardizing, 128, 129
Thistle top funnel tube, 166
Thomas' mill, 200
Thomsonian number six, 499
Three bromides, elixir, **423**
Thuja fluidextract, **589**
Thyme fluidextract, **589**
Thymol spray, **447**
Tilting steam kettle with stirrer, 144
Tinctura aconiti, 464, **469**
ætherea, **495**
aloes, 464, 465, **469**
et myrrhæ, 467, **496**
alstoniæ, **468**
amara, 467, **496**
antiperiodica, 466, **497**
sine aloes, 466, **497**
arnicæ, 464, **470**
radicis, **468**
aromatica, 467, **497**
asafœtidæ, 464, **470**
aurantii amari, 464, **471**
dulcis, 465, **471**
belladonnæ foliorum, 464, **471**
benzoini, 464, **472**
composita, 465, **472**
berberidis, **468**
bryoniæ, 466, **497**
buchu, **468**
cacti grandiflori, 467, **498**
calendulæ, 467, **498**
calumbæ, 464, **473**
cannabis, 464, **473**
indicæ, **473**
cantharidis, 464, **474**
capsici, 464, **474**
et myrrhæ, 467, **499**
caramellis, 466, **499**
cardamomi, 464, **475**
composita, 464, 465, **475**
cascarillæ, **468**
chiratæ, **468**
chloroformi et morphinæ composita, **468**
cimicifugæ, 467, **499**
cinchonæ, 464, **476**
composita, 465, **476**
cinnamomi, 465, **477**
cocci, **468**
cocculi Indici, 466, **499**
colchici seminis, 464, **477**
coto, **506**
croci, 466, **500**
cubebæ, 467, **500**
daturæ seminum, **468**
delphinii, 466, **500**
digitalis, 464, **478**
ergotæ ammoniata, 467, **500**
ferri chloridi, 464, **479**
ætherea, 466, **501**
citro-chloridi, 467, **501**
malatis crudi, **502**
pomata, 466, **502**
gallæ, 467, **502**
gambir composita, 464, 465, **479**
gelsemi, 464, **479**
gentianæ composita, 464, 465, **480**
guaiaci, 465, **480**
ammoniata, 465, **481**
composita, 467, **502**
hamamelidis, **468**
humuli, 467, **502**
hydrastis, 465, **481**
hyoscyami, 464, **482**

Tinctura, ignatiæ, 466, 503
iodi, 464, 482
decolorata, 466, 504
fortior, 467, 503
ipecacuanhæ et opii, 467, 504
jalapæ, 467, 504
composita, 467, 505
kaladanæ, 468
kino, 464, 483, 505
et opii, composita, 466, 505
krameriæ, 467, 505
lactucarii, 465, 483
lavandulæ composita, 464, 465, 484
limonis corticis, 465, 484,
lobeliæ, 464, 485
ætherea, 468
matico, 468
moschi, 464, 485
myrrhæ, 465, 485
nucis vomicæ, 464, 486
oliveri corticis, 468
opii, 464, 486
ammoniata, 468
camphorata, 464, 465, 487
crocata, 466, 506
P. I., 506
deodorati, 464, 488
paracoto, 467, 506
passifloræ, 467, 507
pectoralis, 466, 507
persionis, 466, 507
composita, 467, 508
physostigmatis, 464, 488
picrorhizæ, 468
pimpinellæ, 467, 508
podophylli, 468
Indici, 468
pruni virginianæ, 468
pulsatillæ, 466, 508
pyrethri, 465, 489
quassiæ, 465, 489
quillajæ, 467, 509
quininæ, 468
ammoniata, 468
rhei, 465, 490
aquosa, 466, 509
aromatica, 465, 490
dulcis, 467, 509
et gentianæ, 466, 510
vinosa, 519
sabal et santali, 467, 510
sanguinariæ, 464, 491
saponis viridis composita, 435
scillæ, 464, 491
serpentariæ, 467, 510
senegæ, 468
sennæ composita, 468
stramonii, 464, 468, 492
strophanthi, 464, 492
sumbul, 467, 511
tolutana, 465, 493
valerianæ, 465, 493
ammoniata, 465, 494
vanillæ, 467, 511
veratri viridis, 464, 494
viburni opuli composita, 467, 511
Tinctura, zedoariæ amara, 512
zingiberis, 465, 495
Tincturæ, 461
herbarum recentium, 496
medicamentorum recentium, 496
Tincture aconite, 469
aloes, 469
and myrrh, 496
alstonia, 468
antiperiodic, 497
without aloes, 497
arnica, 470
root, 468
aromatic, 497
asafetida, 470
belladonna leaves, 471
benzoin, 472
compound, 472
berberis, 468
Bestuscheff's, 501
bitter, 496
orange peel, 471
bloodroot, 491
bryonia, 497
buchu, 468
calabar bean, 488
cactus grandifloris, 498
calendula, 498
calumba, 473
cannabis, 473
cantharides, 474
capsicum, 474
and myrrh, 499
caramel, 499
cardamom, 475
compound, 475
cascarilla, 468
chiretta, 468
chloroform and morphine compound, 468
cimicifuga, 499
cinchona, 476
compound, 476
cinnamon, 477
cocculus Indicus, 499
cochineal, 468
colchicum seed, 477
coto, 506
crude malate of iron, 502
cubeb, 500
cudbear, 507
compound, 508
datura seeds, 468
deodorized opium, 488
digitalis, 478
Dover's powder, 504
ergot, ammoniated, 500
ethereal, 495
ferrated extract of apples, 502
ferric chloride, 479
ethereal, 501
citro chloride, 501
fresh drugs, 496
gambir, compound, 479
gelsemium, 479
gentian, compound, 480
ginger, 495
golden seal, 481
green soap, 433
compound, 435
Tincture, guaiac, 480
ammoniated, 481
compound, 502
Dewees', 502
hamamelis, 468
henbane, 481
hops, 502
hydrastis, 481
hyoscyamus, 482
ignatia, 503
Indian podophyllum, 468
iodine, 482
Churchill's, 503
decolorized, 504
stronger, 503
ipecac and opium, 504
jalap, 504
compound, 505
Jamaica ginger, 495
kaladana, 468
kino, 483
and opium, compound, 505
compound, 505
krameria, 505
lactucarium, 483
larkspur, 500
lavender, compound, 484
lemon peel, 484
lobelia, 485
ethereal, 468
matico, 468
musk, 485
myrrh, 485
nutgall, 502
nux vomica, 486
olive's bark, 468
opium, 486
ammoniated, 468
camphorated, 487
with saffron, 506
pale catechu compound, 479
paracoto, 506
passion flower, 507
pectoral, 507
pellitory, 489
physostigma, 488
picrorhiza, 468
pimpinella, 508
podophyllum, 468
pulsatilla, 508
pyrethrum, 489
quassia, 489
quillaja, 509
quinine, 468
ammoniated, 468
rhubarb, 490
and gentian, 510
aqueous, 509
aromatic, 490
sweet, 509
saffron, 500
sanguinaria, 491
saw palmetto and santal, 510
senega, 468
senna compound, 468
serpentaria, 510
squill, 491
stomachic, 496
stramonium, 468, 492
strophanthus, 492

Tincture, sumbul, 511
sweet orange peel, 471
table, 464
tolu, 493
valerian, 493
ammoniated, 494
vanilla, 511
veratrum viride, 494
viburnum, compound, 511
Warburg's, 497
without aloes, 497
wild cherry, 468
zedoary, bitter, 512
compound, 512
Tinctures, 301, 461
assayed, modification for, 463
general formulas, 463
Tinned copper funnel, 234
Title, botanical, 33
official English, 31
Latin, 29
Tobacco cutter, 189
Tolu syrup, 333
tincture, 493
Tongs for crucibles, 138
Torrefaction, 138
Torsion balances, 68
counter scale, 70
prescription balance, 69
Tower pound, 42
Toxicology, 25
Tragacanth glycerite, 378
mucilage, 354
Tralles' hydrometer, 86
Tranquillizing balsam, 602
Trays for desiccating, 185
Triclinic octahedron, 257
prism, 257
Trifolium fluidextract, 589
Trillium fluidextract, 589
Trimetric, or rhombic system, 256
Trimorphous, 255
Triticum decoction, 458
fluidextract, 562
Triturating with a loaded pestle, 203
Trituratio elaterini, 203
Trituration, 202, 301, 647
Troches, 301, 647
Trochiscation, 208
Trochiscator, 208
Troemner's mill, 199
press, 272
scale for weighing liquids, 67
Troy pound, 42, 43
weights, 43, 71
Truncated cube, 256
octahedron, 256
Tube bending and drawing, 163
condenser in use, 170
or specific gravity, 79
bending, 162
Tubes, cutting and bending, 162
drawing, 163
Tubulated and quilled receiver, 165
retort, 161
Tubulure, 161
Tumbler-shaped graduates, 74
Tumblerful, equivalent, 45
Tunnels, 233
Turpentine liniment, 434
acetic, 435
oil, emulsion, 356
Twaddell's hydrometer, 87
Type formula for infusions, 449
process "A," fluidextracts, 521, 529
"B," fluidextracts, 521, 530
"C," fluidextracts, 524, 530
"D," fluidextracts, 527, 531
for decoctions, 457
fluidglycerates, 591
tinctures, "P" and "M," 463
water, 305

U.

Ultra-microscope, 221
Unit of capacity, metric, 45
of length, metric, 45
of weight, metric, 45
United States Dispensatory, 38
Pharmacopœia, 26
Revision, 28
Unmedicated petroxolins, 440
Unofficial glycerites, 374
infusions, 456
liniments, 431
mixtures, 362
oleate, 437
spirits, 385
Upright steam coil, 145
Upward filtration, 236
Urginea vinegar, 603
Urinometer, 86
and jar (Squibb), 85
Uva ursi fluidextract, 563

V.

Vacuum apparatus, 153
dryers, 154
percolation, 526
pump, 154, 240, 242
stills, 154
Valerate, ammonium elixir, 401
quinine, and strychnine elixir, 420
strychnine elixir, 421
zinc, elixir, 424
Valerian fluidextract, 590
tincture, 493
ammoniated, 494
Valve funnel, 236
Vanilla percolator, 294
tincture, 511
Vanillin, elixir, compound, 423
spirit compound, 393
Vapor tension, 150
Vaporization, 147
questions, 159
Venezuela Pharmacopœia, 26
Venice turpentine petrox, 445
petroxolin, 445
Vent of furnace, 117
Veratrine oleate, 439
Veratrum viride fluidextract, 563
tincture, 494
Verbena fluidextract, 590
Very coarse powder, 207
fine powder, 207
Vesicating collodion, 428
Vessels for crystallizing, 261
for evaporating liquids, 152
used in precipitation, 253
Vest pocket prescription scale, 66
Viburnum opulus elixir, compound, 424
fluidextract, 590
prunifolium, elixir, 424
extract, 636
fluidextract, 564
tincture compound, 511
Villate's mixture, 363
Vina medicata, 512
Vinegar aromatic, 604
cantharidin, 603
Indian squill, 603
opium, 604
squill, 604
urginea, 603
Vinegars, 301, 603
medicated, 603
table, 603
Vinum antimonii, 513, 514
aurantii, 519
compositum, 513, 514
earnis, 513, 515
et ferri, 513, 515
colchici cormi, 514, 515
seminis, 513, 516
ferri, 513, 516
amarum, 513, 516
fraxini, 514, 517
ipecacuanhæ, 513, 517
pepsini, 513, 518
picis, 513, 518
pruni virginianæ, 514, 518
ferratum, 513, 519
quininæ, 519
rhei compositum, 513, 519
xericum, 513
Volatile liniment, 432
liquids, filtering, 237
oils, spirit, 393
Volume and weight relations, 94
specific, 92

W.

Warburg's tincture, 497
without aloes, 497
Warner's filter, 236
Wash, black, 372
bottle, 220
camphor, ammoniated, 372

Wash, lead and opium, **372**
yellow, **372**
Washes, questions, 381
Washing by displacement, 222
continuous, 222
crystals, 261
precipitates, 254
Water, 213
anise, **306**
as solvent, 213
bath, 140
for decoction, **456**
effervescent salts, 265
bitter almond, **306**
camphor, **307**
carbolic acid, **311**
chloroform, **307**
cinnamon, **308**
cologne, **392**
creosote, 308
crystallization, 260
decrepitation, 261
distilled, **308**
sterilized, **309**
fennel, **309**
hamamelis, **309**
heater, 125
orange flower, **306**
stronger, 307
peppermint, **310**
phenolated, **311**
pump, 239, 241, 244
rose, **310**
stronger, 311
sedative, **372**
sifting, 208
spearmint, **310**
still, Stokes', 179
witch hazel, 309
Waters, 301, 302
aromatic, **305**
by distillation, 304
general process, 305
official in the British Pharmacopœia, 311
preservation, 304
questions, 316
Wedge press, 275
Wedgwood crucibles, 137
mortar and pestle, 203
Weighing, 60
Weight, 41
Weight and volume relations, 94
equivalents, metric, 50
for percolator, 288
metric, 47
unit, metric, 45
Weights, ancient, 41
apothecaries', 43
avoirdupois, 43, 71
cup, 71
Imperial, 42
mediæval, 41
metallic, 70
metric, 72
modern, 41
origin, 41
prescription, 72
troy, 43, 71
wire, aluminum, 73
Well tube percolator (Squibb), 290
Welter's safety tube, 167
Westphal specific gravity balance, 89
Whisky, 385
Whitall, Tatum Co.'s still, 172
White ash, wine, 514, **517**
liniment, **436**
pine syrup, compound, **346**
with morphine, **346**
Wickless blue flame coal oil stove, 121
Wiegand's still, 172
Wild cherry fluidextract, **584**
infusion, **455**
syrup, **331**
tincture, **468**
wine, **518**
ferrated, **519**
with cod liver oil emulsion, **359**
Wine measure, 44
antimony, **514**
beef, **515**
and iron, **515**
citrate of iron, **516**
colchicum corm, **515**
colchicum seed, **516**
ipecac, **517**
iron, **516**
Wine, iron, bitter, **516**
orange, **519**
compound, **514**
pepsin, **518**
quinine, **519**
rhubarb, compound, **519**
sherry, **512**
tar, **518**
white ash, **517**
wild cherry, **518**
ferrated, **519**
Wineglassful equivalent, 45
Wines, 301
medicated, 512
table, 513
Wintergreen spirit, **385**
Wire cage, 178
for sieves, 205
weights, 73
Witch hazel, extract, distilled, **309**
water, **309**
Wood, 116
Wooden mortars and pestles, 192
stirrer, 153
Woollen strainers, 226
Worm condenser, 171

X.

Xanthoxylum fluidextract, **564**

Y.

Yard, 42, 43
Yellow Lotion, **372**
Wash, **372**
Yerba santa elixir aromatic, **409**
fluidextract, **545**
syrup, aromatic, **339**

Z.

Zanetti's hydrometers, 87
Zea fluidextract, **591**
Zedoary tincture, bitter, **512**
compound, **512**
Zinc valerate elixir, **424**
oleate, **437**
Zittmann's decoction. milder, **458**
stronger, **458**
Zoology, 25